1. Term 1
    1. Mechanisms and motion
    2. Levers
    3. Pulleys and gears
    4. Cams
    5. Screws
2. Term 2
    1. Structures
    2. Specifications for a new classroom
    3. Orthographic projections in drawings
    4. The skill of drawing on scale
3. Terms 3 and 4
    1. How hydraulic systems work
    2. Calculating the mechanical advantage of a hydraulic system
    3. How valves function in hydraulic systems
    4. Build a hydraulic system

Mechanisms and motion

TECHNOLOGY

Grade 9

MECHANISMS AND MOTION

Module 1

MECHANISMS AND MOTION

Introduction

What is a mechanism?

- In our everyday life we are surrounded by mechanisms. They help make our life easier in many ways. Most of the mechanisms you use are so familiar that you never think about them. Simple things like door handles, light switches, parts of a bicycle and a car are only a few examples. In the past, in old machines such as steam engines, the mechanisms were easy to see. Today they are hidden behind panels and covers. Mechanisms allow us to do simple things like switching on lights, running a bath and peddling up the hill easily on a bicycle. You will discover the uses of different mechanisms, as we look at them closer in this module.

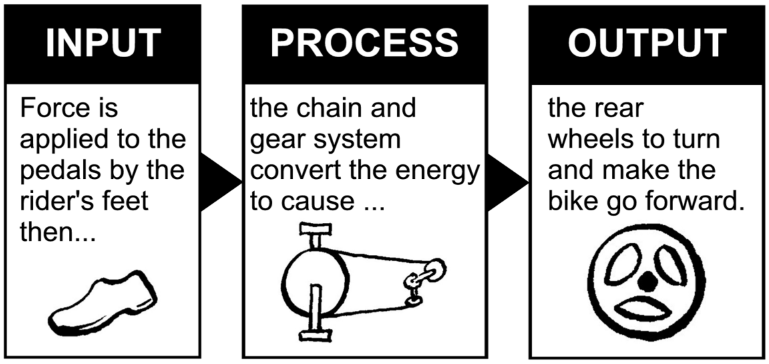
Activity 1

- Make a list of items that you think are examples of mechanisms? Sketches and pictures of these items can also be included.

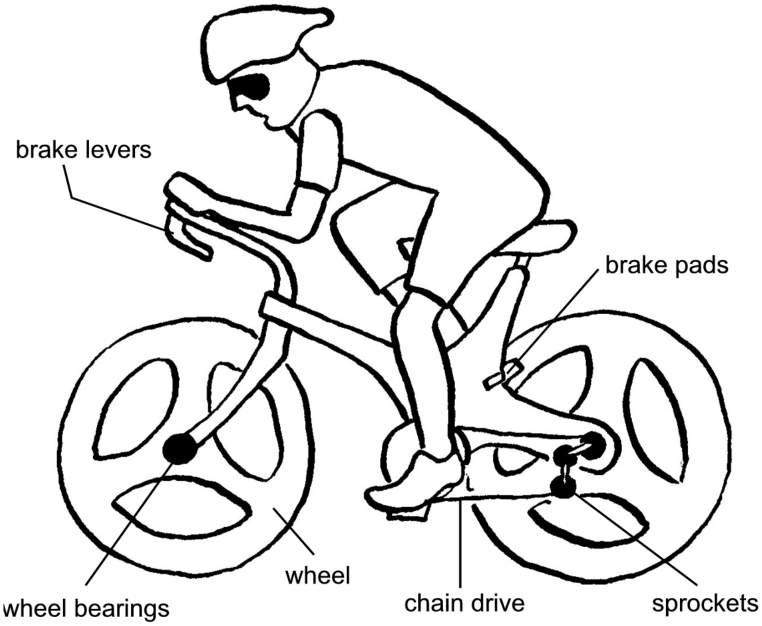
	LO 1.2			

Mechanisms and Motion

- Mechanisms can be used to change the speed, direction or force required to do something. Mechanisms may be able to help you but they cannot do it on their own. They need energy and someone or something to operate them. The energy that is used by a machine is called the input. The result of this energy input is called the output. A mechanism such as a bicycle can be explained with the diagram below.

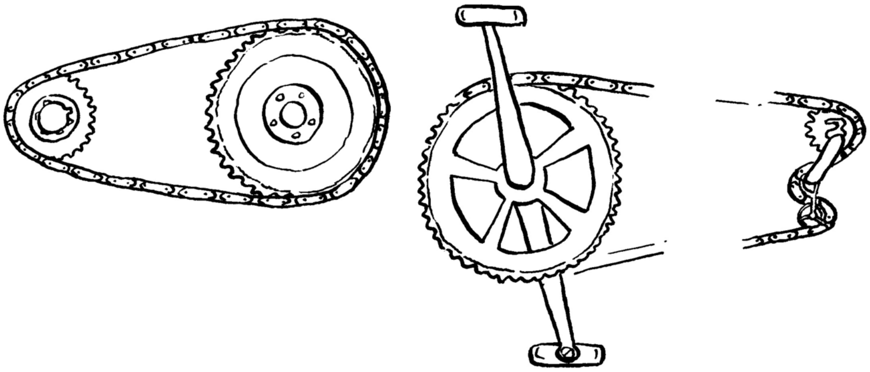

INPUT
Force is applied to the pedals by the rider's feet then...
PROCESS
the chain and gear system convert the energy to cause ...
OUTPUT
the rear wheels to turn and make the bike go forward.

Systems diagram for a bike as a mechanism



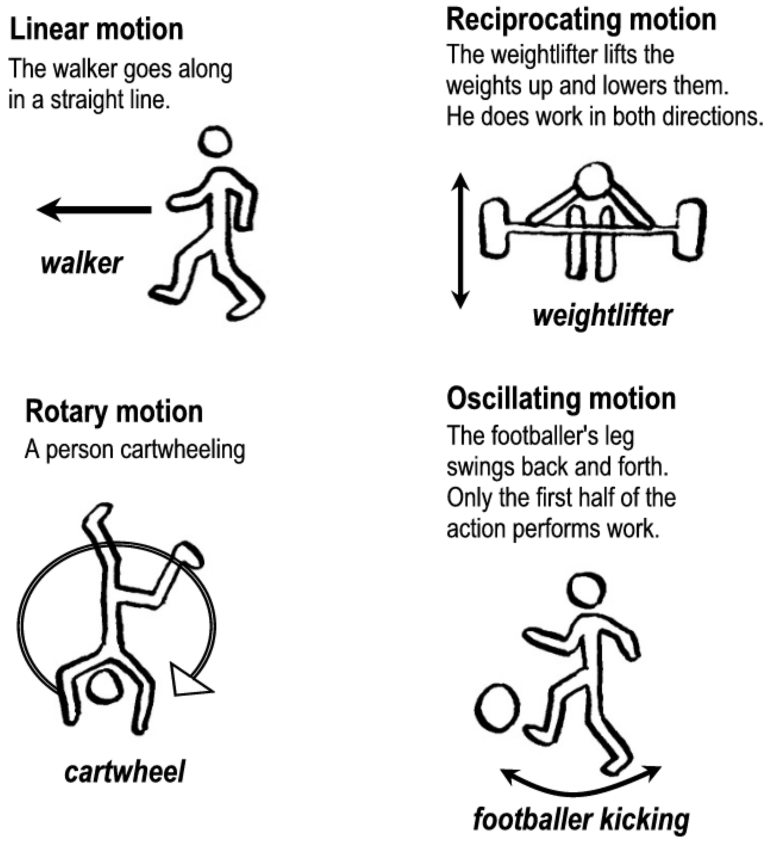
Activity 2

- Explain the advantages of sprockets and chains used in bicycles.



	LO 2.3			

- Mechanisms are concerned with motion. There are four main types of motion. These can be illustrated by means of human body movements.



Linear motion

The walker goes along in a straight line.

Reciprocating motion

The weightlifter lifts the weights up and lowers them. He does work in both directions.

Rotary motion

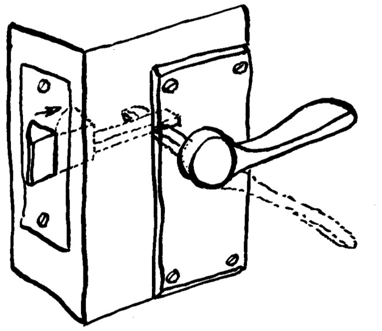
A person cartwheeling

Oscillating motion

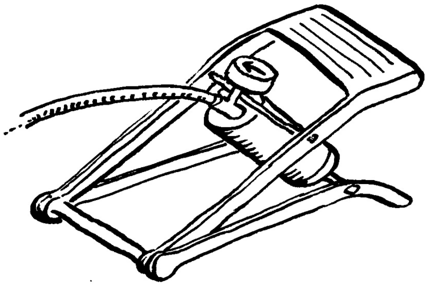
The footballer's leg swings back and forth. Only the first half of the action performs work.

Activity 3

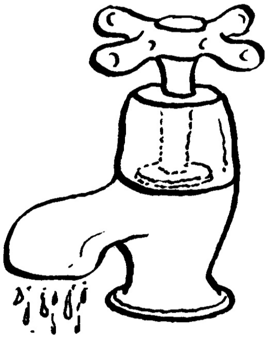
- Name the type of motion illustrated by the products. Use arrows to indicate the direction of the motion.Product



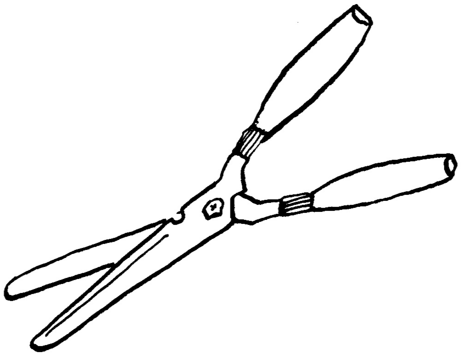
Type of motion __________________Product



Type of motion ____________________Product



Type of motion _______________________Product



Type of motion _________________

	LO 2.3			

Types of mechanisms

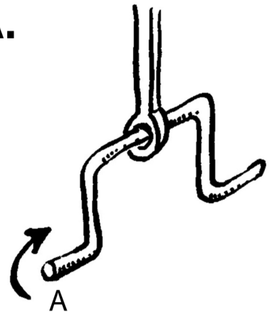
Mechanisms are used in machinery. There are **five types** of mechanism:

1. **Levers** enable forces to be applied at precise points.
2. **Pulleys** change the direction and speed of a movement, and allow the transmission of power.
3. **Gears** transmit rotary motion and force.
4. **Cams and cranks** convert uniform input motion to non-uniform output motion.
5. **Screws** allow rotary motion to transmit a linear force.

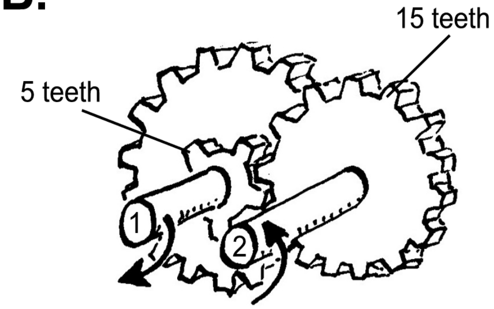
Activity 4

- Answer the following questions based on the pictures A – F.

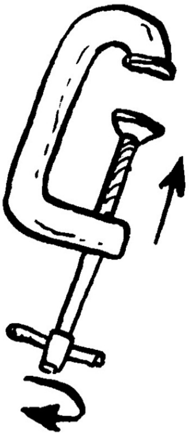
A.



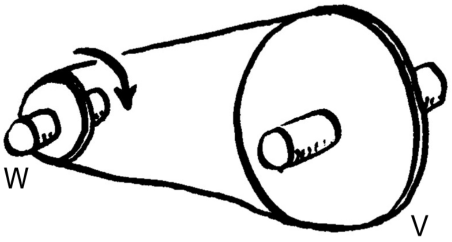
B.



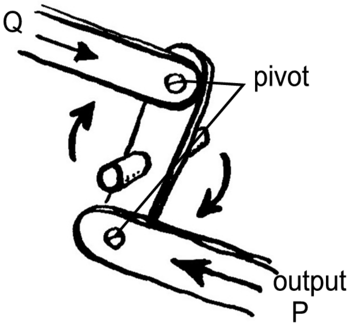
C.



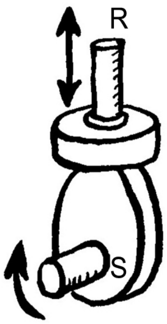
D.



E.



F.



1. Name the mechanism in each of A - F.
2. Suggest a use for mechanism A.

1. In B, Axle 1 rotates at 10 rpm. How fast will axle 2 rotate?

1. To what use may mechanism C be put?

1. In D, if W rotates clockwise, how can you make V rotate anticlockwise?

1. Sketch a toy that could use mechanism F.

	LO 2.3			

Assessment

Learning outcomes(LOs)
LO 1
TECHNOLOGICAL PROCESSES AND SKILLS The learner will be able to apply technological processes and skills ethically and responsibly using appropriate information and communication technology.
Assessment standards(ASs)
We know this when the learner:
investigates:1.2 analyses existing products relevant to an identified

problem, need or opportunity based on:

- safety;
- suitability of materials;
- fitness for purpose;
- cost;
- manufacturing method;

LO 2

TECHNOLOGICAL KNOWLEDGE AND UNDERSTANDING The learner will be able to understand and apply relevant technological knowledge ethically and responsibly.

We know this when the learner:

systems and control:2.3 demonstrates knowledge and understanding of interacting mechanical systems and sub-systems by practical analysis and represents them using system diagrams:

- gear systems;
- belt drive pulley systems with more than one stage;
- mechanical control mechanism (e.g. ratchet and pawl, cleats);
- pneumatic or hydraulic systems that use restrictors;
- one-way valves;
- systems where mechanical, electrical or pneumatic or hydraulic systems are combined;

Memorandum

ACTIVITY 1

- Learners could list any product that they regard as a mechanism. The aim of the activity is to help the learners to become aware of how many products actually are mechanisms. Discuss their examples in the classroom.

ACTIVITY 2

2.1 Greater forces can be transferred

2.2 Chains do not slip/slide

2.3 Chains can be unlinked to facilitate removal

ACTIVITY 3

- Door handle Oscillating (handle) and backwards and forwards-movement (reciprocating)
- Tap Rotating movement
- Air pump Oscillating
- Pair of scissors Oscillating

ACTIVITY 4

1. A – Crank(-handle)

B – Gears

C – Propeller/screw

D – Pulley

E – Linkage/linking

F – Cam

1. Tricycle
2. Three times slower (15/5 = 3)
3. Store air-tight/Keep things tightly stored
4. Twist the rubber ring to form an 8.
5. Any cam-driven toy

Levers

TECHNOLOGY

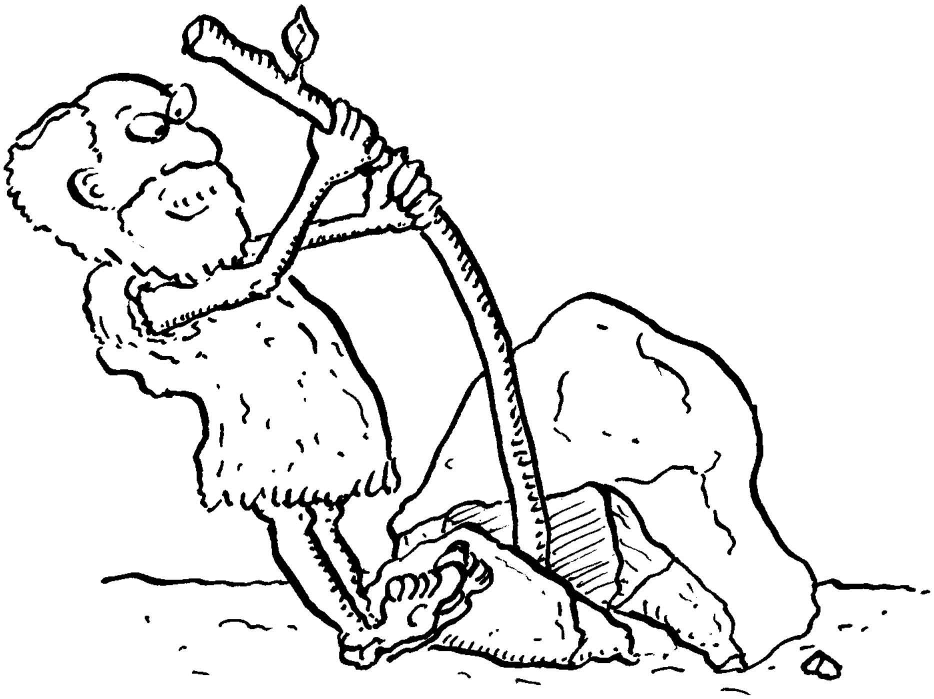
Grade 9

MECHANISMS AND MOTION

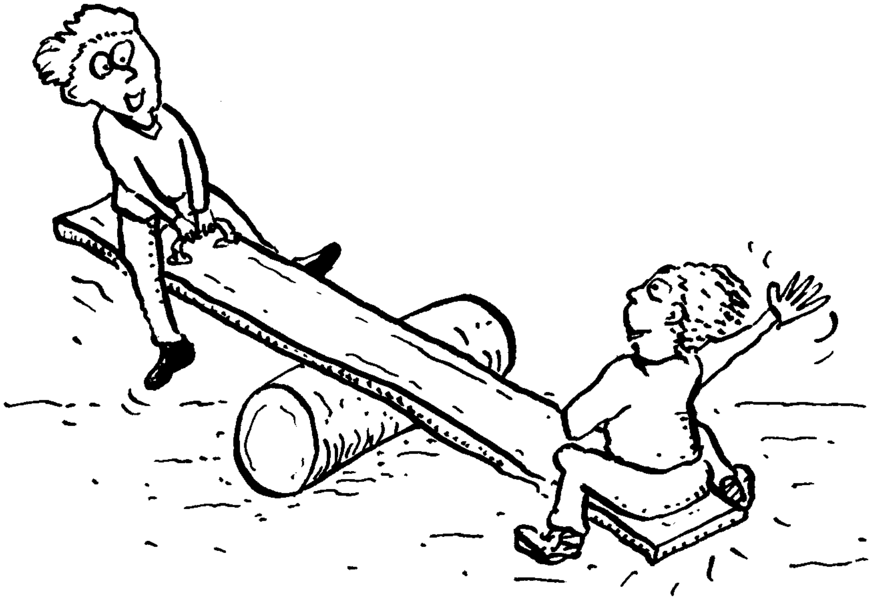
Module 2

LEVERS

- One of the oldest mechanisms is the lever. Stone Age people used them to move large objects.



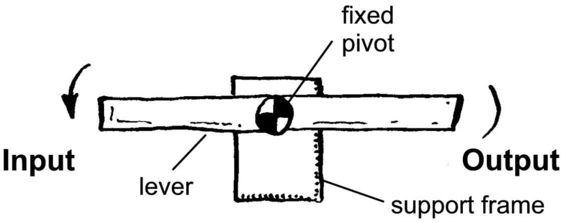
- A lever can be described as a long rigid object with a pivot point somewhere along its length. The pivot is a fixed point about which the lever rotates. The pivot is also known as the fulcrum. Levers are used to do two things: they can move a large load with only a little effort, or they can increase or amplify movement. A seesaw is a simple example of a lever.

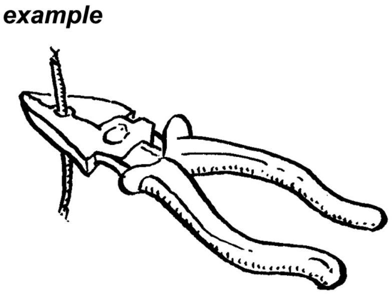


Class 1 lever

- This lever type is like a seesaw, which has a fixed pivot in the centre of the lever.

Give another example:

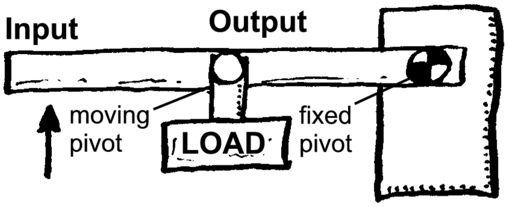


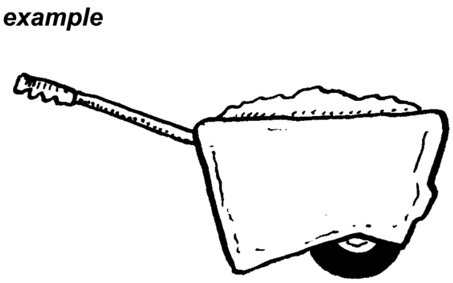


Class 2 lever

- This lever type has the output between the input and the pivot. A wheelbarrow is an example.

Give another example:

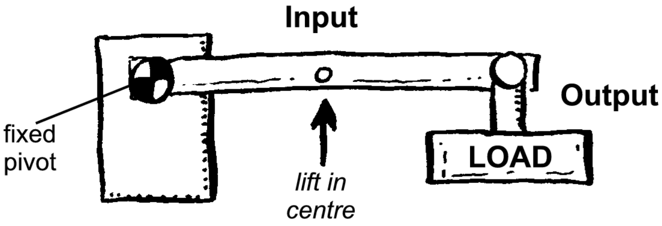


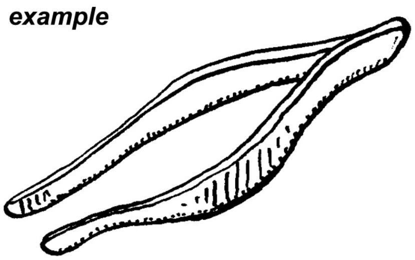


Class 3 lever

- This lever type has the input between the pivot and the output. A tweezers is an example of this type of lever.

Give another example:





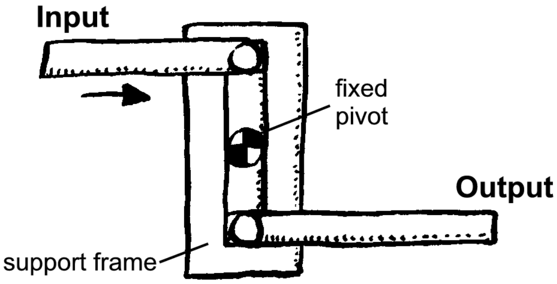
Linkages

- Linkages are levers that link up to other levers, wheels, connecting rods, flywheels etc. They can change the direction of a movement, the size of a force, or make things move in a particular way. The samples illustrate different linkages. You can easily construct them using cardboard, scissors, paper fasteners and drawing pins and test the effect of each linkage.

Push/pull link

- This is a linkage useful for changing direction.

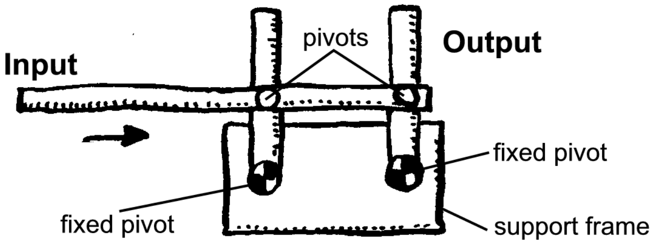
Give another example:



Wiper blades

- This linkage allows the input link to move parallel to the support frame, like a car windscreen wiper.

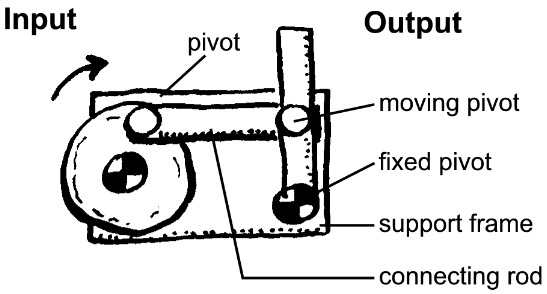
Give another example:



Waving arm

- The connecting rod is moved by the wheel, which moves the arm.

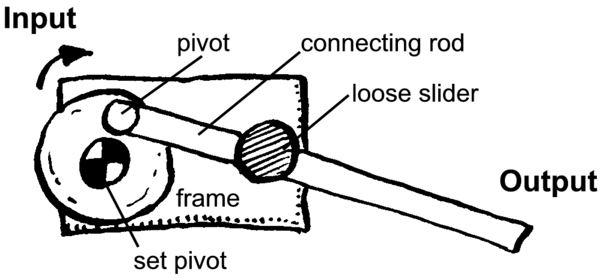
Give an example:



Slider

- The wheel turns the connecting rod, which moves through the slider.

Give another example:



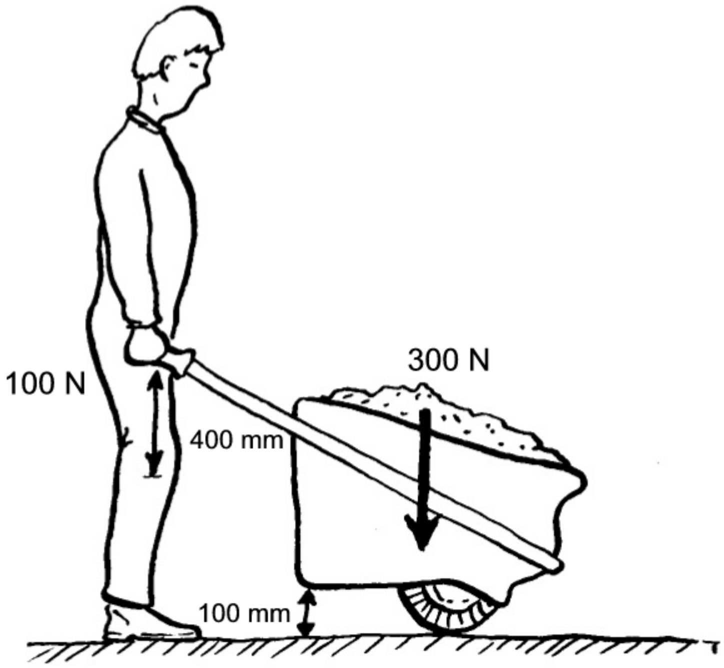
	LO 2.3			

Mechanical Advantage

- We use levers every day because they make it is easier to get work done. They give us mechanical advantage (MA) which means that you can move a large load using a small effort.
- The MA in the example below is found by comparing the weight of the load with the effort needed to move it. (Remember 1kg = 10 Newton)

$$\mathbf{MA} = \frac{\text{Load}}{\text{Effort}} = \frac{400\text{ N}}{100\text{ N}} = \frac{4}{1} = 4$$

Velocity Ratio



- If you look at wheelbarrow example again you will see that the distance the effort has to move is much further that that of the load. By comparing the two distances you get the velocity ratio (VR).

$$\mathbf{VR} = \frac{\text{Distance moved by effort}}{\text{Distance moved by load}} = \frac{40\text{ cm}}{10\text{ cm}} = \frac{4}{1} = 4{:}1$$

Efficiency

- Mechanisms are not always 100% efficient due to factors such as parts that bend, friction etc.
- In everyday terms, the formula will be:

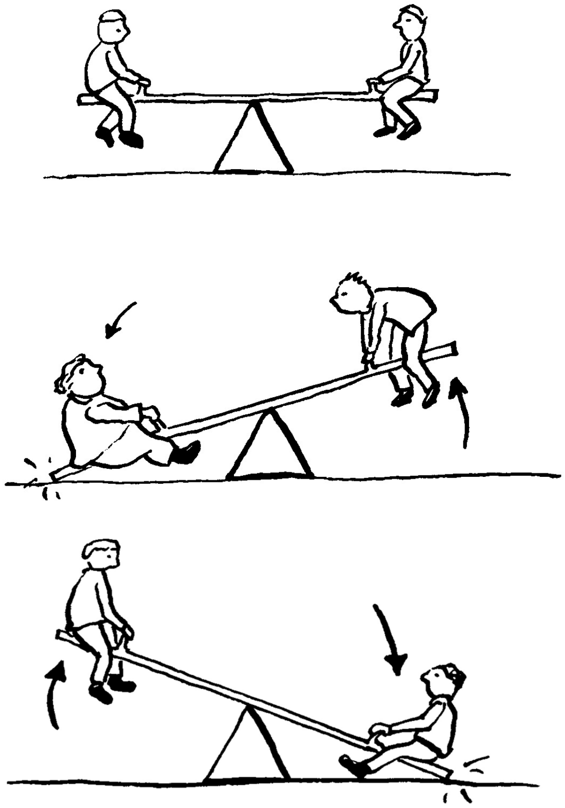
$$\textbf{Efficiency} = \frac{\text{Work done}}{\text{Work put in}} = \text{\% efficiency}$$

- The scientific formula for the calculation of the efficiency of a mechanism is as follows:

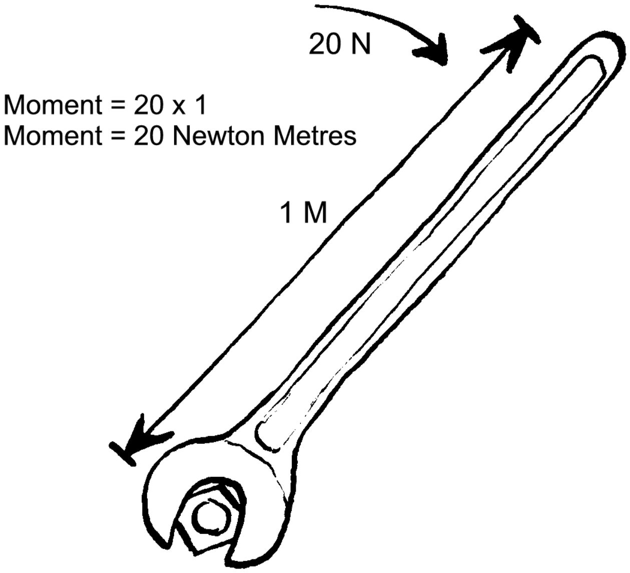
$$\textbf{Efficiency} = \frac{\text{MA}}{\text{VR}} \times 100\ \%$$

Moments

- If a seesaw is not moving but remains level, it is said to be balanced. The forces on either side of the fulcrum are equal and opposite. If the force on one end of the seesaw is greater than the other, or if the fulcrum is not in the centre, then the seesaw will rotate around the fulcrum. This turning force is known as a *moment*.



- Moments can be used to work out unknown weights or distances of movement. The figure below shows how to calculate the moment for a very large spanner.



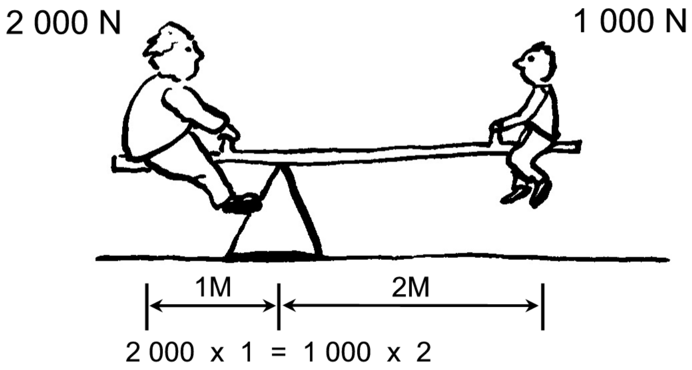
Activity 1

Use a simple sketch to help explain the principle of moments.

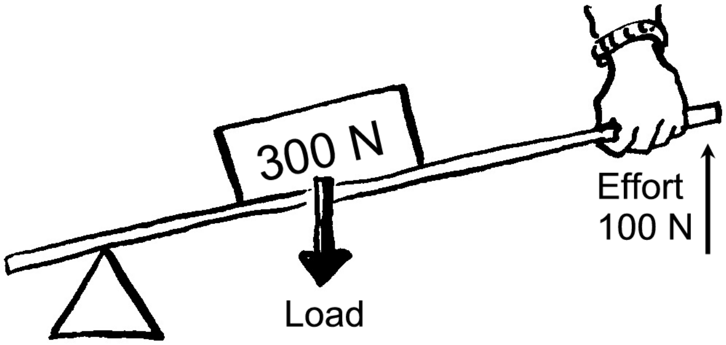
1. Write down in your own words the formula to calculate moment (read it from the illustration):

Moment =

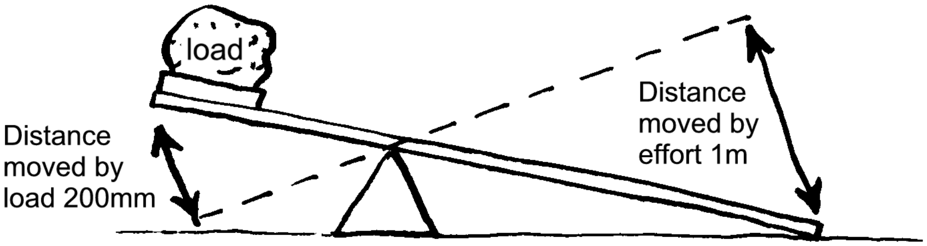
1. If a man weighing 560 N is sitting 3 metres from the pivot of a seesaw, how far from the pivot must a man weighing 700 N sit to create a state of equilibrium (balance)?



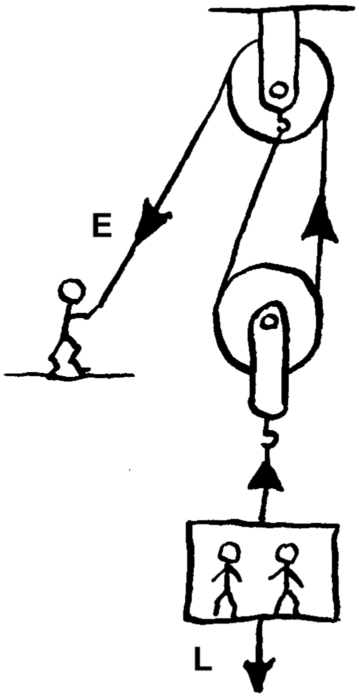
1. Calculate the mechanical advantage of the lever shown in the illustration.



What is the velocity ratio of the lever shown in the figure?



1. Work out the efficiency of the lifting system in the illustration. It was found that an effort of 50N moving 8m could lift a load of 80N through a distance of 4 m.



	LO 2.3			

Assessment

LO 2
TECHNOLOGICAL KNOWLEDGE AND UNDERSTANDING The learner will be able to understand and apply

relevant technological knowledge ethically and responsibly.

We know this when the learner:

systems and control:2.3 demonstrates knowledge and understanding of interacting mechanical systems and sub-systems by practical analysis and represents them using system diagrams:

- gear systems;
- belt drive pulley systems with more than one stage;
- mechanical control mechanism (e.g. ratchet and pawl, cleats);
- pneumatic or hydraulic systems that use restrictors;
- one-way valves;
- systems where mechanical, electrical or pneumatic or hydraulic systems are combined;

Pulleys and gears

TECHNOLOGY

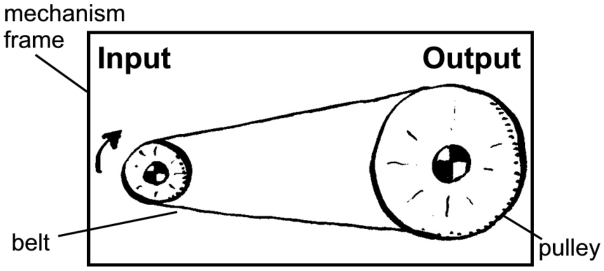
Grade 9

MECHANISMS AND MOTION

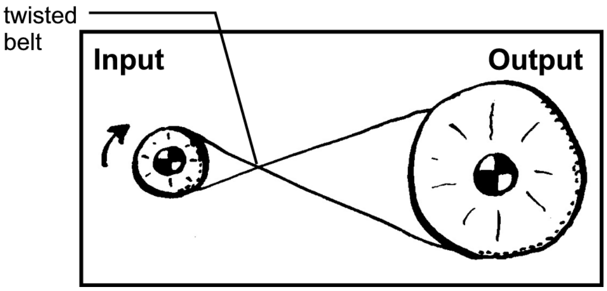
Module 3

Pulleys and Gears

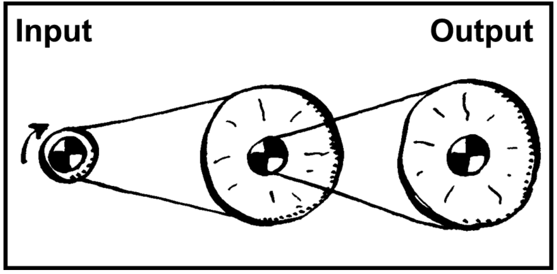
- Pulleys and gears are used to transfer rotary motion from one place to another. Both are wheels. Pulleys are wheels with grooves in the rims, in which a belt or rope can run. Pulleys can transfer rotary motion from one shaft to another or can be used to lift heavy loads.
- Gears are wheels with teeth evenly spaced around the rims. Several gears can be placed, so that their teeth interlock, or mesh. When two or more gears are used together, they form what is called a gear train. Gears can be used to change the speed and direction in which something rotates. When chains are used to connect the "gears", a chain and sprocket system is formed, for example on bicycles and motorcycles.Simple pulley



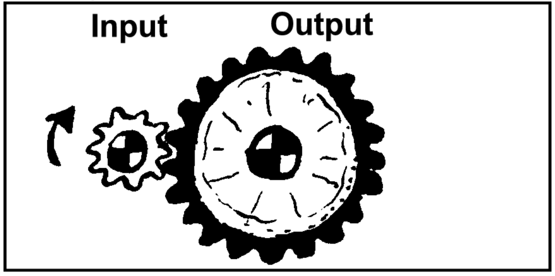
Twisted pulley



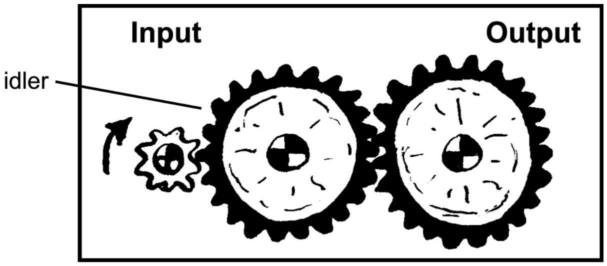
Compound pulley



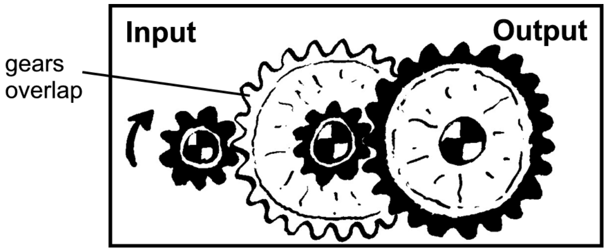
Two gears



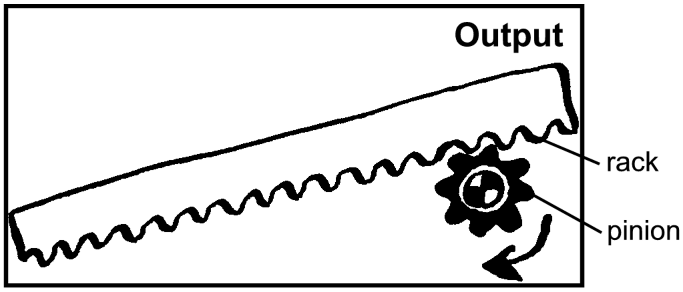
A Gear train



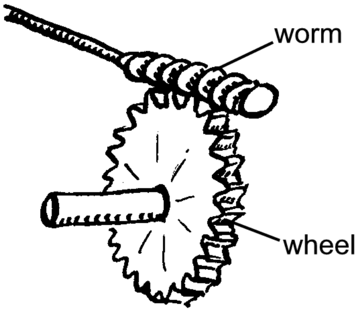
Compound gears



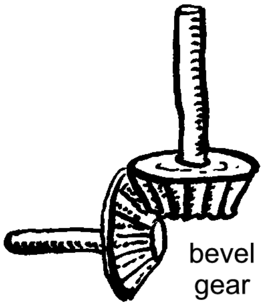
Rack & Pinion



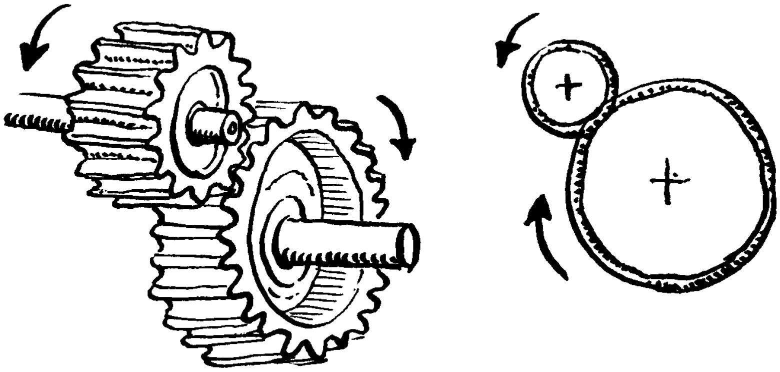
Worm and wheel



Bevel gears



Gear Systems



- The illustration shows gears fixed to parallel shafts, forming a simple gear train. The gear fixed on the drive shaft is called the driver gear and is connected to the driven gear. The shafts will turn in opposite directions and, because the gears have different sizes, they will turn at different speeds. The difference in their speeds (velocity ratio) can be calculated from the number of teeth on each gear.

$$\mathbf{VR} = \frac{\text{No. of teeth on driven gear}}{\text{No. of teeth on driver gear}} = \frac{40}{20} = \frac{2}{1} = 2{:}1 \text{ of } 2$$

- This means that in this case the driver shaft must turn twice for the driven shaft to complete one turn.

Pulley Systems

- Pulley systems use a belt to transmit motion and force from the driver shaft to the driven shaft. Cars use a pulley system with V-belts running in grooves on the pulley wheels. Speed changes are made by using different sizes of pulleys on the driver and driven shafts respectively. By comparing the sizes of the two pulleys you can calculate the velocity ratio (VR) of the system.

- If the diameter of the driver pulley in a pulley system is 100 mm and that of the driven pulley 25 mm,

$$\textbf{VR} = \frac{\text{Driven pulley diameter}}{\text{Driver pulley diameter}} = \frac{25}{100} = 1:4$$

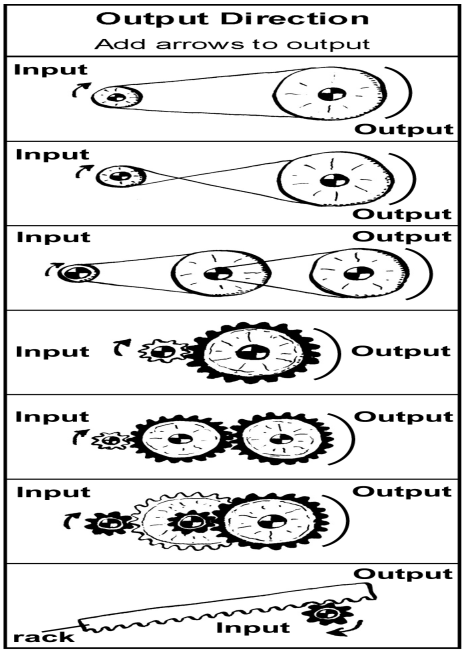
- This means that one turn of the driver shaft will give four turns of the driven shaft. The speed of the driven shaft can be calculated as follows:

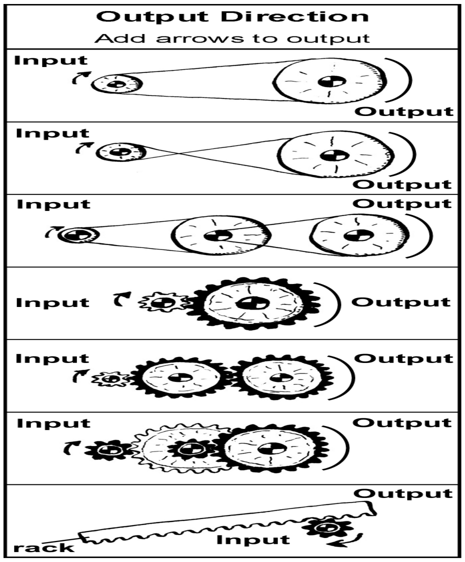
$$\textbf{Output speed} = \frac{\text{Input speed}}{\text{Velocity ratio (VR)}}$$

- If the input speed is 2000rpm and the VR 1:4 the output speed is 8000 rpm.

Activity 1

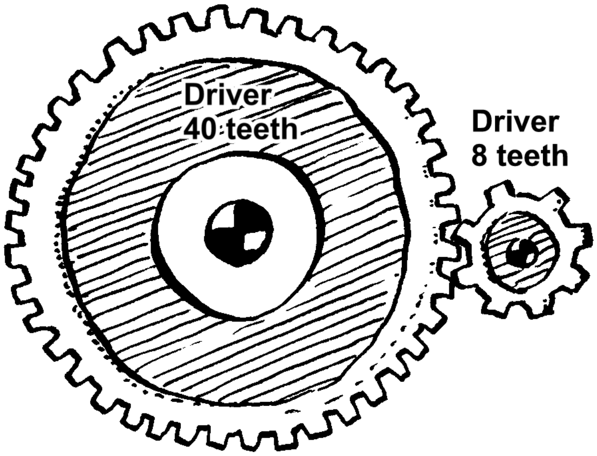
1. Add arrows to the sketches to indicate the output direction.





1. Sketch the cross-section of a V-belt and pulley.
2. Give two examples of the use of pulley systems.

1. The figure shows two gears in mesh:



4.1 If the input speed is 1 250 rpm what is the output speed?

4.2 How could the driver and driven gears be made to rotate in the same direction?

1. What are the advantages and disadvantages of chain and sprocket systems compared to pulley systems?

	Advantages	Disadvantages
Chain and sprocket systems		
Pulley systems		

	LO 2.3			

Assessment

LO 2
TECHNOLOGICAL KNOWLEDGE AND UNDERSTANDING The learner will be able to understand and apply relevant technological knowledge ethically and responsibly.
We know this when the learner:
systems and control:2.3 demonstrates knowledge and understanding of interacting mechanical systems and sub-systems by practical analysis and represents them using system diagrams: • gear systems; • belt drive pulley systems with more than one stage; • mechanical control mechanism (e.g. ratchet and pawl, cleats); • pneumatic or hydraulic systems that use restrictors; • one-way valves; • systems where mechanical, electrical or pneumatic or hydraulic systems are combined;

Memorandum

ACTIVITY 1

1.	

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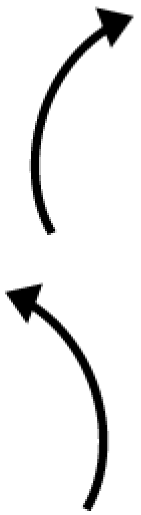
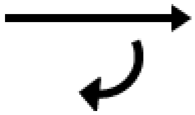
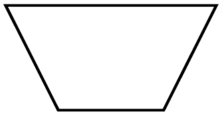
	⤴ ↶
	⤴ ⤵

2.



1. Drilling machine, Block and tackle

- $\frac{80}{4} \times \frac{1250}{1}$ = 250 ohm
- Insert idling gear

4. Advantages of tooth gears and chains

- Greater forces can be transferred
- Chains do not slip/slide
- Chains can be disassembled for removal

5.Advantages of pulleys and belts

- Belts are not noisy
- Belts can be stretched for fitting and for removal
- Crossed belts can change the direction of rotation

Cams

TECHNOLOGY

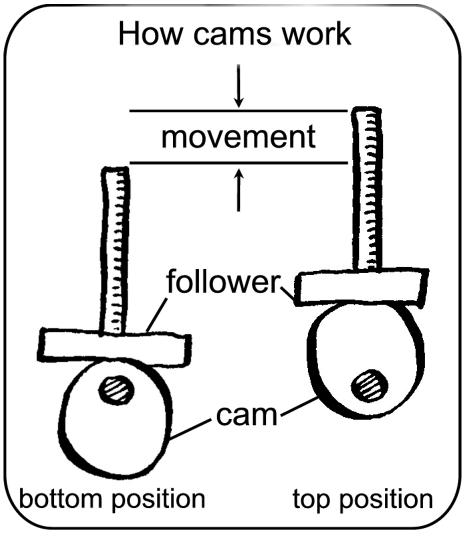
Grade 9

MECHANISMS AND MOTION

Module 4

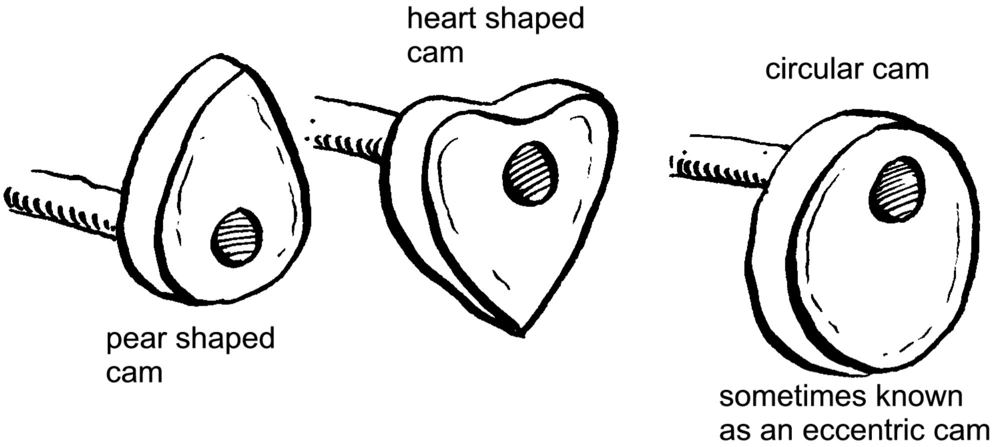
CAMS

- Cams, change one type of motion into another. There are two types, linear and rotary. Rotary cams are very common in machines and are used to change rotary motion into reciprocating motion. Cams are asymmetrical forms that are fixed on a rotating shaft. The form, size and position of the shaft in the cam will determine the distance and movement of the output shaft attached to the follower. A follower follows the cam that gives the desired output.



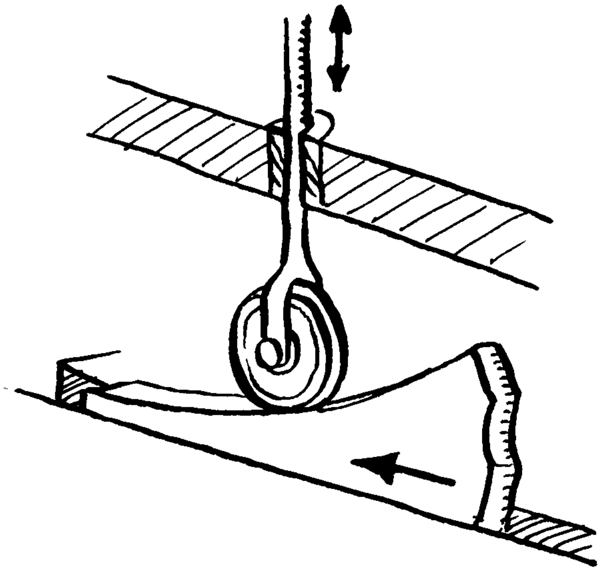
Rotary or circular cams

- These cams change rotary motion into reciprocating (backwards and forwards) motion. They are usually made from metal or plastic and are fitted on a shaft. A spring or the weight on the follower keeps it on the cam. Rotary cams can vary in shape from circular to heart and pear shapes.



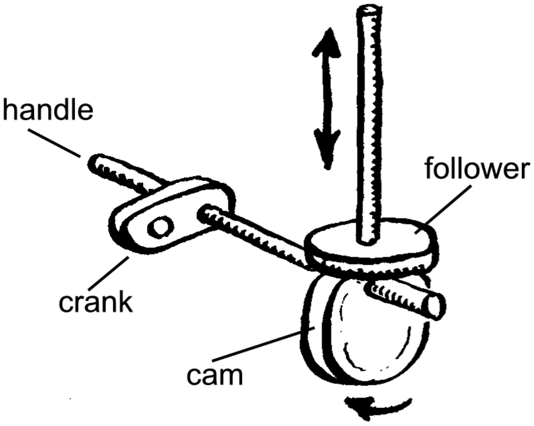
Linear Cams

- These cams change the direction of reciprocating motion. The cam can have any profile and moves backwards and forwards while the follower follows the profile. With these cams the follower normally has a small wheel to allow the movement to be smooth.

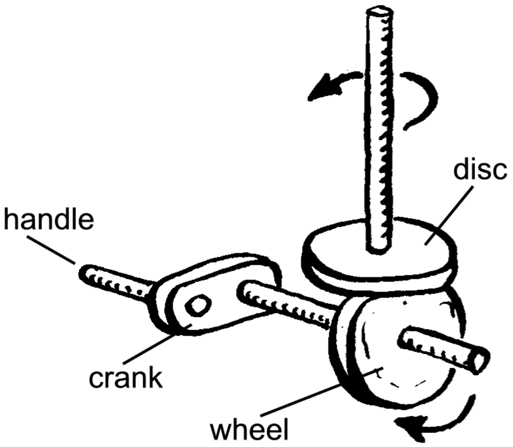


- Input rotary motion can be obtained by fitting a crank to the handle. The output movement depends on various factors. The sketches below illustrate three different ways of getting output movement.

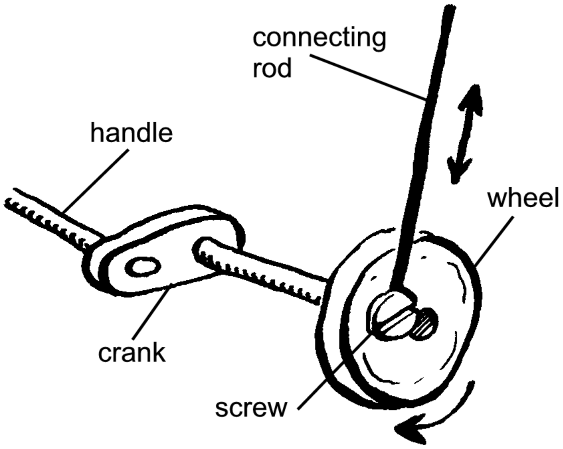
1. Cam operated – up and down movement



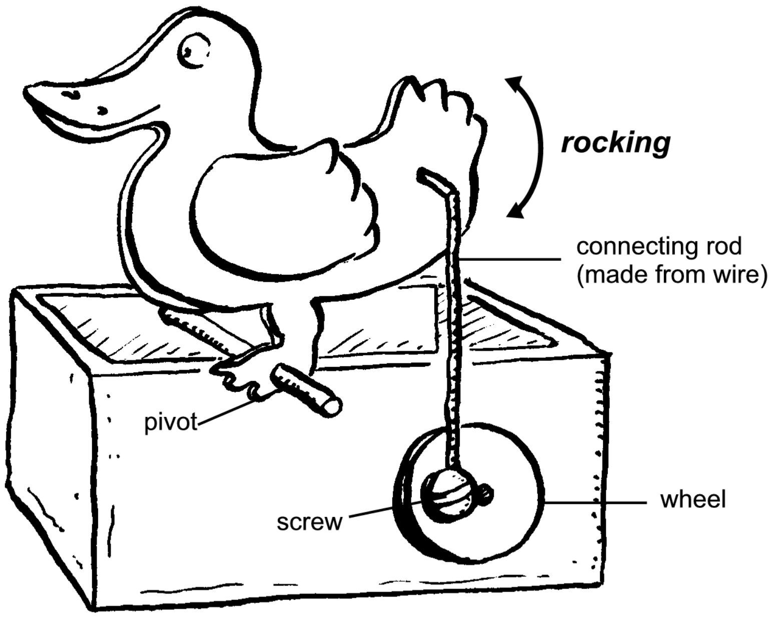
2. Friction wheel - shaft pins



3. Wheel and connecting rod



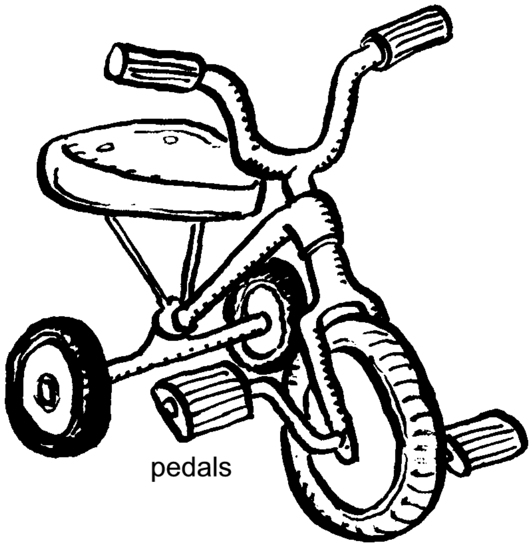
- By applying the basic principles you can easily construct a hand operated mechanism without becoming too technical.



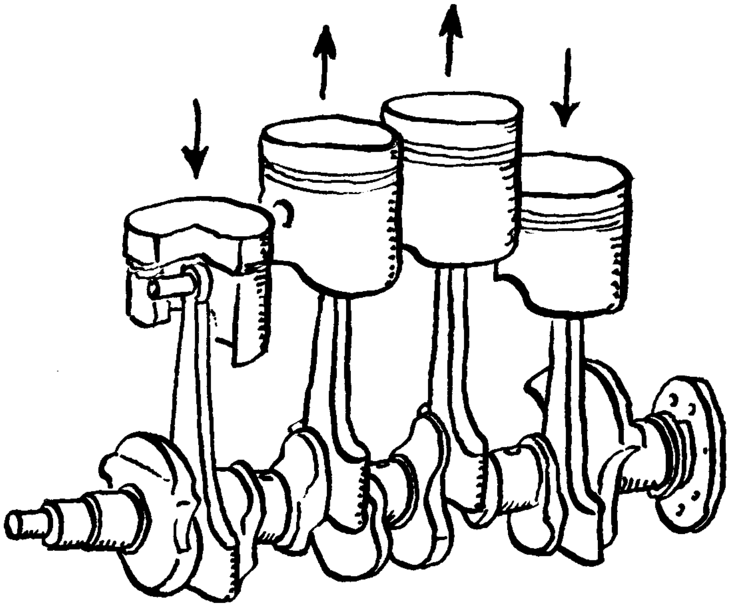
Rocking duck

The Crank

- The steam engine is a good example of the crank mechanism (crank/slider). The crank uses the wheel and axle principle. Can you all remember pedalling on your first tricycle? The wheel and pedal shaft is a good example of a crank.



- Several crank handles can be put together to form a crankshaft. The crankshaft forms a very important function in basically every machine with moving parts. The pistons in a car are pushed up and down by the crankshaft.



Activity1

1. Make a simple sketch of a crank handle that you can use in a hand operated mechanical toy.
2. Draw three different shapes of cams. Also illustrate the difference each will have in the output movement.
3. Give two examples where cams and cranks are used in machines.

	LO 2.3			

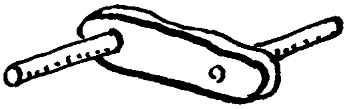
Assessment

LO 2
TECHNOLOGICAL KNOWLEDGE AND UNDERSTANDING The learner will be able to understand and apply relevant technological knowledge ethically and responsibly.
We know this when the learner:
systems and control:2.3 demonstrates knowledge and understanding of interacting mechanical systems and sub-systems by practical analysis and represents them using system diagrams: • gear systems; • belt drive pulley systems with more than one stage; • mechanical control mechanism (e.g. ratchet and pawl, cleats); • pneumatic or hydraulic systems that use restrictors; • one-way valves; • systems where mechanical, electrical or pneumatic or hydraulic systems are combined;

Memorandum

ACTIVITY 1

1.



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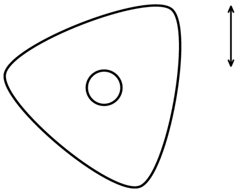
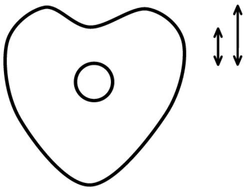




3.

- Crank-handle ------- crankshaft / tricycle
- Cam ------- Cam on camshaft

Screws

TECHNOLOGY

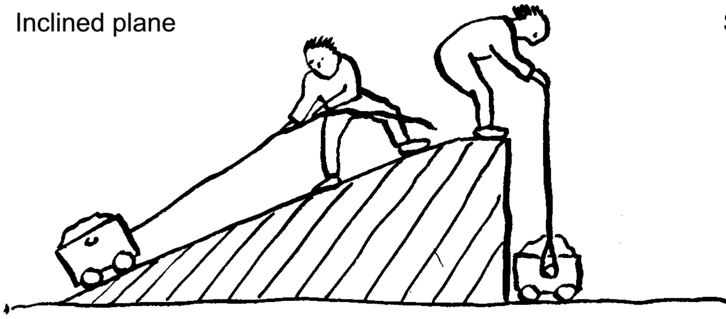
Grade 9

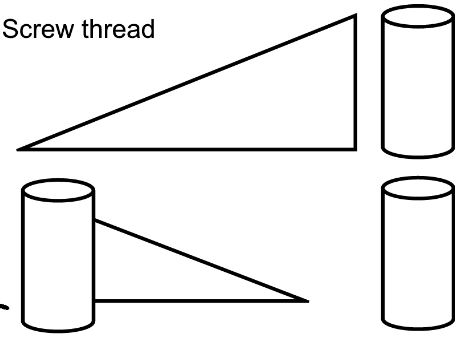
MECHANISMS AND MOTION

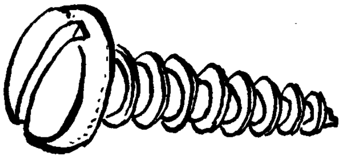
Module 5

SCREWS

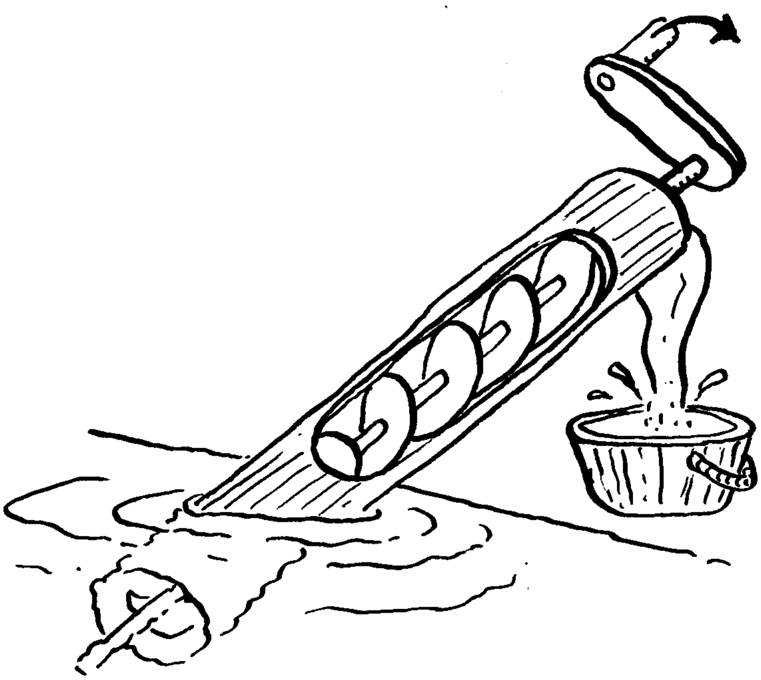
- Screws differ from nails because they have a thread. Screw thread make use of inclined plane principle. What is an inclined plane? It is simply a sloping surface used to make jobs easier like in the picture below.







- Screw threads are used to provide powerful movement, for instance in car jacks, to hold things in place (e.g. nuts and bolts) and to position things accurately (e.g. to adjust a shifting spanner). There is more technical information regarding screws, such as different thread types, which you would learn about if you were to become an engineer.



Activity 1

Questions based on the picture.

1. Name two mechanisms used in this device.

1. This invention proved to be useful in the olden days. Why?

1. Are there modern versions of this mechanism? Explain.

1. Write a brief paragraph on how the development of mechanisms has affected the waste industry and the mechanical equipment they use. Also reflect on the effect this could have on the environment.

	LO 3.2			

Your Challenge

- You have learnt a lot about mechanisms in this module. You might have found some mechanisms more interesting than others. You might also say that this is too technical for you or that the calculations are too difficult.
- The truth is that everyone use mechanisms every day. Whether they are technical or not, people have to open doors with handles, switch on lights with lever switches and change gears with a gearlever.
- We now set you two challenges. Use the Technological process and produce a project portfolio to solve the problems. In both only a scenario is given. You need to write your own design brief, specifications, ideas, final idea, manufacture (scenario 2 = scale model) and evaluation. Your educator will guide you on what materials and tools are available.

Scenario 1

- Since Technology is a fairly new subject in schools, educators find it very difficult to explain and demonstrate mechanisms. There are very few resources and examples and little equipment available from the South African education department. Choose any mechanism and design and make a demonstration mechanical tool, example or mechanical toy which an educator can use.

Scenario 2

- Many people are keen on 4x4 outings. This has opened a new market for 4x4 accessories. Equipment needs to be strong, light and must be able to fold up to take as little space possible when travelling. There is a variety of equipment available and designers are still producing brilliant new ideas for the 4x4 enthusiast. You are part of such a design group whose task is to design and evaluate new products for this market.

Assessment

LO 3
TECHNOLOGY, SOCIETY AND THE ENVIRONMENT The learner will be able to demonstrate an understanding of the interrelationships between science, technology and the environment.
We know this when the learner:
impact of Technology:3.2 recognises and identifies the impact of technological developments on the quality of people’s lives and on the environment in which they live, and suggests strategies for reducing undesirable effects.

Memorandum

ACTIVITY 1

1. Screw and crank-handle

2. First kind of pump. Worked manually, electricity not available. Rivers were the main source of drinking water – no taps in houses.

1. Pumps used in bore-holes.
2. For this essay, learners have to do research on how mechanisms have been used to facilitate the improvement of the waste industry. They also have to determine the possible effects on the environment.

Structures

TECHNOLOGY

Grade 9

ARCHITECTURAL PLANNING

Module 6

STRUCTURES

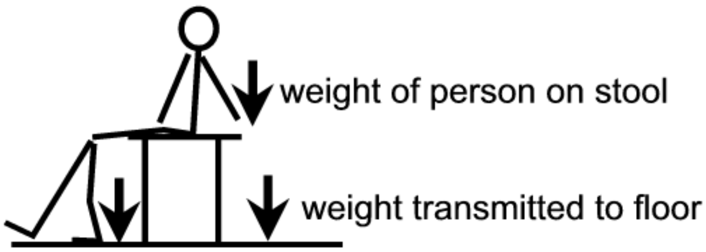
Activity 1:

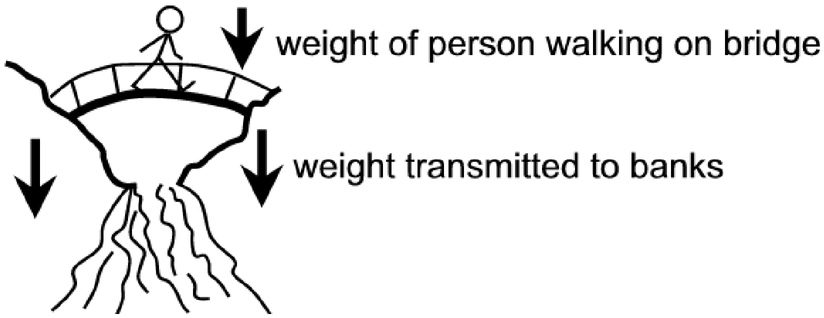
To be able to explain the term ‘structure’.

A structure can be defined as a body that can resist applied forces without changing its shape or size, apart from the deformations due to the elasticity of the materials from which it is made.

In order to design safe, efficient structures we need to understand the effects of forces. The study of forces at rest is called **statics**, while **dynamics** refers to the study of forces on bodies in motion.

The main function of a structure is to transmit forces from one place to another. If you sit on a stool, it transmits your weight to the floor. If you walk across a bridge, the bridge transmits the weight to the banks. Objects that serve as structures can have additional purposes.




weight of person walking on bridge
weight transmitted to banks

The walls of a house form a structure for transmitting various forces to the ground but together with the roof they also provide shelter from the elements. Later in this module you are going to design and make an additional building (classroom) for your school. Your design will involve aesthetic as well as technical considerations. You will try to give your structure an attractive appearance so as to enrich the environment.

Focus task A

1. Explain in your own words what a structure is.

2. Give examples of structures in your immediate environment.

3. Make a list of all possible purposes of structures that you can think of. In each case give an example of a structure to explain how the purpose is served.

	LO 2.1			

Activity 2:

To be able to distinguish between different types of structures

Mass structures: These are solid structures such as gravity dams that resist the applied forces by virtue of their own weight.

Frame structures: Bars are joined together at their ends to form a framework, often called skeletal structures. If the bars all lie in the same plane they are termed “plane frames” but if they extend in three dimensions we use the term “space frames”. It is often necessary to cover a space frame with some form of sheet material e.g. a tall building cladded with glass.

Shells: In contrast to frame structures a shell transmits the forces imposed on it through the sheet material of which it is made. Many items like cars were previously designed as a frame (chassis) covered with sheet materials. These days they are designed as shells with the forces being transmitted by the sheet material forming the skin (*monocoque construction*). The shell is often reinforced with stiffeners that help to preserve its shape and thereby add to its strength. A study of the strength of materials is included in engineering courses as a subject called *mechanicsof solids.*

Focus task B

- Make sketches of examples in your environment of the following:

1. Mass Structure

2. Plane frame

3. Space frame

4. Monocoque construction

	LO 2.1			

5. Produce an information sheet on materials that can be used as sheet material for buildings.

6. What does “reinforced” mean?

7. Give examples of reinforced materials.

	LO 2.2			

Assessment

LO 2
TECHNOLOGICAL KNOWLEDGE AND UNDERSTANDING The learner will be able to understand and apply relevant technological knowledge ethically and responsibly.
We know this when the learner:
structures:2.1 demonstrates knowledge and understanding of

structures:

- properties of materials that affect their performance in structures;
- analysis of the effects of different loads;

processing:2.2 demonstrates knowledge and understanding of how materials can be processed to change or improve properties (life-span), and how recyclable materials can be re-manufactured.

Memorandum

Focus task A

1. Learners must show a clear understanding of what a structure is. Activity 1 explains what a structure is.

2. Any structure from natural to man-made example. Houses, roofs, birds' nests, bicycle frame, caves, etc.

3. Supports – ladder, chairsProtects – House, birds nestsContains - Swimming pool, shopping bagSpans distances – bridge, washing line

Focus task B

1 Dam walls, reservoirs

2 Bicycle frame

3 Electric power supply tower

4 Car, e.g. Volvo

5. This sheet must contain information on sheet material such as glass, board products, metal products which are used by builders nowadays. The learners need to do research on this assignment.

6. The term means that a material has been made stronger by adding a material of strength in its structure. In most concrete buildings these days metal rods reinforce the concrete.

7. Reinforced concreteWood, e.g. plywoodGlass that contains metal strips

Specifications for a new classroom

TECHNOLOGY

Grade 9

ARCHITECTURAL PLANNING

Module 7

SPECIFICATIONS FOR A NEW CLASSROOM

Activity 1:

To write a design brief and specifications for a new classroom

Situation:

- Due the large intake this year in your school an additional classroom must be planned and built. You must work in groups (2 - 4) and make a decision on where this additional building will be built. Your group must measure (in meters) the available site and make notes of the existing infrastructure such as existing buildings, water points and environmental features like trees, etc.

Focus task A

1. Write a design brief for the given problem.

	LO 1.5			

2. Write specifications for your new classroom.

	LO 1.6			

3. Make a 2-D sketch of the existing buildings and environmental features of the area in which you are planning to build the new classroom. Consider the impact that this new classroom might have on the environment.

- Possible impact on environment

	LO 1.1			

Activity 2:

To collect information on the requirements regarding the new classroom

- In order for us to design a new classroom we need to gather data from various parties like the principal, teachers, learners, parents, etc. to be able to produce solutions to the problem. Through this investigation you must show an understanding of the existing school design and construction, the size required, the money available, etc.

Focus task B

1. Design and develop a questionnaire that can be used to survey opinions from the school community. Use your own paper and insert the questionnaire as additional pages to follow after this one.

2. Present the data gathered by the questionnaire in a graph. (Use excel or powerpoint if possible). Insert the graph as an additional page.

	LO 1.4			

Activity 3:

To present ideas concerning the new classroom by means of oblique drawings

Focus task C

- Produce ideas of how your group is planning to build the new classroom. Use oblique drawings.

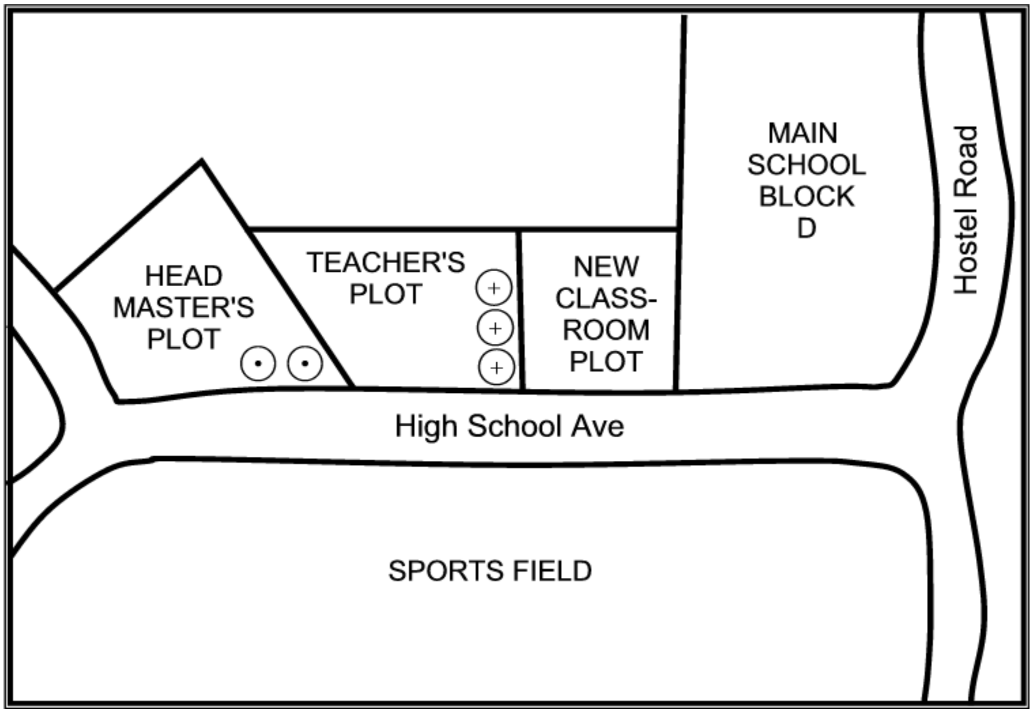
	LO 1.7						LO 1.9			

Activity 4:

To draw a block plan to show the positioning of the new classroom

Focus task D

- Also draw a block plan which shows the roads, outlines of the buildings and site boundaries. It is important to indicate where North is on this plan. Indicate North by using an arrow (↑).
- You can include the outline dimensions, waste pipe, trees, manhole and drainpipes on the sketch to make it a site plan.



	LO 1.9			

Activity 5:

To master the skill of drawing to scale

You will understand that it will be impossible to draw the classroom in its actual size on an A4 sized paper. It is always desirable to draw an object to its actual size (scale 1:1) which means that 1 mm on the drawing equals 1 mm of the actual size of the item. However many items are just too big and must be scaled down to fit on paper while others, like electric components are just too small and must be scaled up.

In the formula that is used to indicate the scale, the first number represents the measurement unit that is used in the drawing, while the second number says what size this unit represents on the real object. This means that a drawing made to a scale of 1:2 is a reduction (half full size): the unit by which the drawing is measured, represents 2 such units on the real object. In other words, 1 mm on the drawing will be 2 mm on the real object. A scale of 2:1 on the contrary, means that the drawing is an enlargement, twice the full size of the object.

Focus task E

1. A 1:500 scale drawing, shows a wall to be 10 mm long. How long will the wall be in the real building?

2. You have to show a window of 2 m wide on a 1:100 scale drawing. How wide will the window measure on your drawing?

	LO 1.9			

Assessment

Learning outcomes(LOs)
LO 1
TECHNOLOGICAL PROCESSES AND SKILLS The learner will be able to apply technological processes and skills ethically and responsibly using appropriate information and communication technology.
Assessment standards(ASs)
We know this when the learner:
investigates:1.2 analyses existing products relevant to an identified problem, need or opportunity based on: • safety; • suitability of materials; • fitness for purpose; • cost; • manufacturing method;
designs:1.5 writes or communicates a short and clear statement or a design brief for the development of a product or system related to a context, problem, need or opportunity that has been identified by self;
1.6 lists product specifications and design specifications and

constraints for a solution to an identified problem, need or opportunity based on all of the design key words listed below:

- people, age, target market, human rights, access;
- purpose, function, what the product will do;
- appearance and aesthetics: form, colour, shape, feel;
- environment: where product will be used or made, impact on the environment in the long and short term;
- safety: for users and manufacturers;
- cost: cost of materials, wastage, cost of manufacture, maximum selling price;
- ergonomics;
- quality;
- production;

1.7 generates a range of possible solutions that are significantly different from each other, and that show clear links to the design brief and specifications and constraints;

1.8 chooses possible solutions based on well-reasoned argument related to the specifications and personal opinions, and develops a chosen idea using graphics;

makes:1.9 develops plans for making that include all of the following:

- resource lists (e.g. materials lists, tools, people, cost);
- formal drawings showing dimensions or quantities (e.g. orthographic, oblique or isometric views, sequence drawings, exploded views);
- manufacturing sequence;

1.10 chooses and uses appropriate tools and materials to make designed products with precision and control by measuring, marking, cutting or separating, shaping or forming, joining or combining, and finishing a range of materials accurately and efficiently;

1.11 uses measuring and checking procedures while making to monitor quality and changes, and adapts designs in response to practical difficulties encountered when making the products;
1.12 demonstrates knowledge and understanding of safe working practices and efficient use of materials and tools;
evaluates:1.13 evaluates the product or system based on self-generated objective criteria linked directly to the design brief, specifications and constraints using self-designed procedures (e.g. surveys, questionnaires, testing procedures) for self-testing, and suggests sensible improvements or modifications that would clearly result in a more effective or higher-quality end product.

Memorandum

ACTIVITY 1

- Learners are expected to work in groups of 2 to 4. It will be necessary for the learners to go to the site where they plan to build the new classroom. They must do an analysis of the new site. This analysis will be evident in focus task C. They can take paper to the site to make notes and write down measurements (measure your steps: 1 step = 1 metre). The learners must then use this data to produce a formal sketch of the site in class (Focus task C).
- They must also write their own design brief and specifications for their classroom in Focus task C. The brief must be something simple, like *Design a new classroom for the new grade 8's.*
- The specifications must be the requirements for an ordinary classroom, including the following:

- the size - 40 learners must fit in comfortably
- ventilation
- lighting (electric and natural)
- materials
- number of desks

- shape of classroom
- blackboard?
- doors, etc.

- The learner is forced to do research in Focus task D. They must gather data through a questionnaire and must present this data in the form of a graph. If you have computers available this presentation can be done in programmes such as Excel and PowerPoint.
- The ideas must be 3 dimensional in the form of oblique or isometric. Use the grid paper provided. The learners can place a clear sheet of paper on top of the grid so that they can use the grid over and over again.
- The following focus tasks all involve graphical communication. It is important to emphasise neatness and tidiness when it comes to formal drawings. If you have examples of block plans, house plans or even the plan of the school available, it will help learners to comprehend what it is all about. The concept of scale is always confusing and must be explained with care.
- Focus task H and I must be done thoroughly. The attached example will indicate to you what the desirable outcome must be. If you do not have any background on orthographic drawings it is advisable to use a woodwork textbook or even ask the woodwork or technical drawing educator on this issue.
- This module allows learners to design a classroom in many ways and through different graphical methods. Although the group produces only one scale model, every group member must have his own portfolio. In the end their final idea must be realistic so that they can make a scale model from cardboard. Cardboard is very easy to use, since you only need tools like safety rulers, cutting knives, glue and scissors. The learners can leave the roof or just part of it open to show their layout on the inside. It is advisable that the learners plan their manufacturing by producing a flow chart of the manufacturing process.
- Since the learners are all familiar with classrooms they are the best persons to use for evaluating the final products. This evaluation can be done in the form of a presentation – just like an architect will sell his plans to a company.

Orthographic projections in drawings

TECHNOLOGY

Grade 9

ARCHITECTURAL PLANNING

Module 8

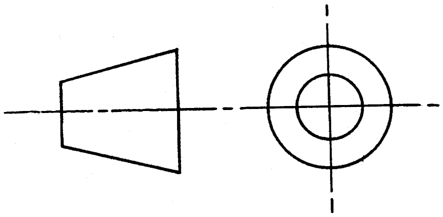
ORTHOGRAPHIC PROJECTIONS IN DRAWINGS

Activity 1:

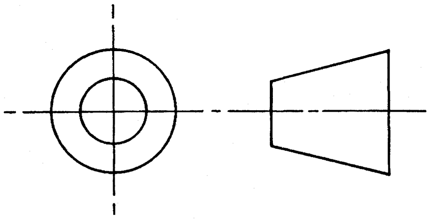
To be able to distinguish between types of lines that are used in drawings

- Several different types of line are used to make drawings clearly understandable. . The appearance of a final drawing will depend on the quality of the lines drawn, so it is certainly worth taking care in this area.

Orthographic projection: First Angle and Third Angle Projection. The views in both will be the same but the projection on paper differs. The symbols below are used on drawings to indicate which projection is used.



First angle projection symbol



Third angle projection symbol

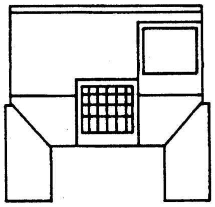
- For this exercise we will only look at First Angle Projection. Your educator will provide you with grid paper which makes it easier for you to draw. If you have drawing equipment it is even better.

- Always start by drawing the front elevation since this will determine the position of the other views. The plan view is drawn below the front elevation, and the end views on the side furthest away from their position on the front view. Each view only shows two dimensions and together they combine to give a three-dimensional description of the object.

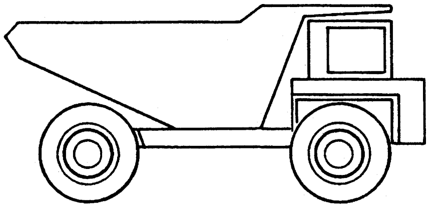
- The example below illustrates Orthographic views in the first angle projection.

Focus task a

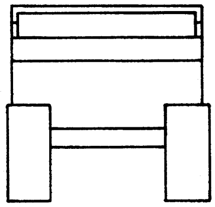
- Draw a first angle projection of your space case on scale 1:2



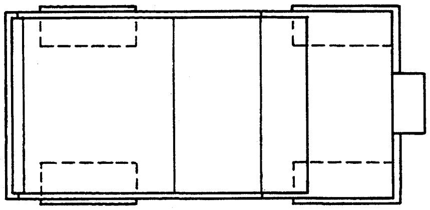
END A ELEVATION



FRONT ELEVATION



END B ELEVATION



PLAN

	LO 1.5						LO 1.9			

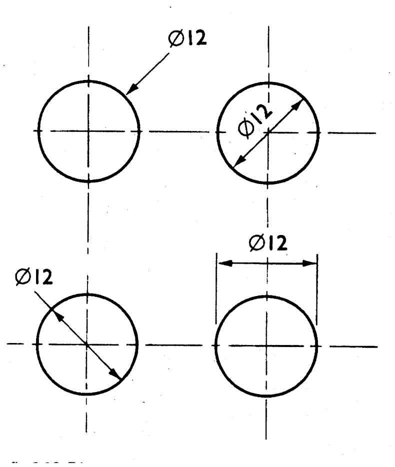
Activity 2:

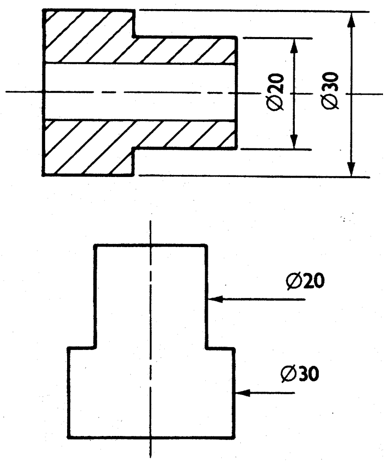
To be able to draw dimension drawings

- Drawings need to be dimensioned to show what the size of the object is in real live. The dimensions should be the real dimensions of the object. There are international rules for the application of dimensions:

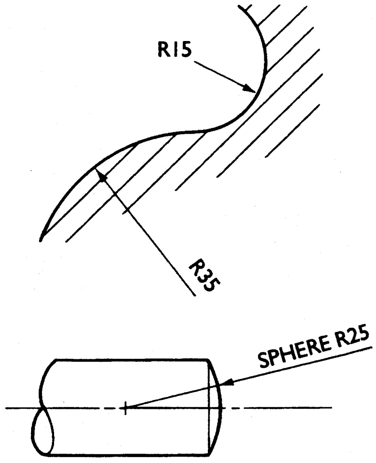
- All dimensions should be read from the bottom or right-hand side of the paper
- Limit lines should be drawn out from the object and numbers written above the dimensioning lines stretching between these
- Smaller measurements should be placed closer to the drawing

Study these examples:

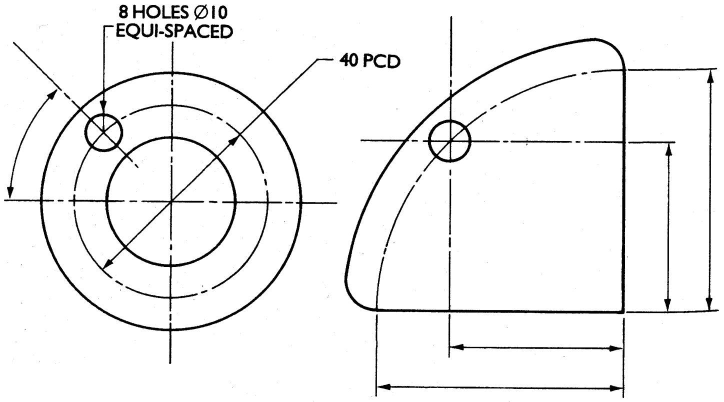




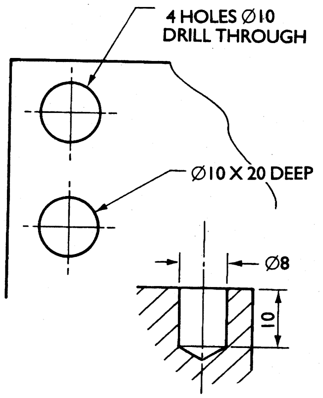
diameters



RADII



POSITION OF HOLES



SIZE OF HOLES

	LO 1.15			

Assessment

Learning outcomes(LOs)
LO 1
TECHNOLOGICAL PROCESSES AND SKILLS The learner will be able to apply technological processes and skills ethically and responsibly using appropriate information and communication technology.
Assessment standards(ASs)
We know this when the learner:
investigates:1.1 identifies and explains a problem, need or opportunity from a real-life context, and investigates the context, the nature of the need, the environmental situation, and the people concerned;

1.4 uses a variety of available technologies and methods to:

- locate (e.g. use library referencing system, database searches, indexes);
- collect (questionnaires, data collection forms, requests for information, information searches, literature surveys);
- compare;
- sort;
- verify;
- evaluate;
- store information;

designs:1.5 writes or communicates a short and clear statement or a design brief for the development of a product or system related to a context, problem, need or opportunity that has been identified by self;

1.6 lists product specifications and design specifications and constraints for a solution to an identified problem, need or opportunity based on all of the design key words listed below:

- people, age, target market, human rights, access;
- purpose, function, what the product will do;
- appearance and aesthetics: form, colour, shape, feel;
- environment: where product will be used or made, impact on the environment in the long and short term;
- safety: for users and manufacturers;
- cost, cost of materials, wastage, cost of manufacture, maximum selling price;
- ergonomics;
- quality;
- production;

1.7 generates a range of possible solutions that are significantly different from each other, and that show clear links to the design brief and specifications and constraints;

makes:1.9 develops plans for making that include all of the following:

- resource lists (e.g. materials lists, tools, people, cost);
- formal drawings showing dimensions or quantities (e.g. orthographic, oblique or isometric views, sequence drawings, exploded views);
- manufacturing sequence;

The skill of drawing on scale

TECHNOLOGY

Grade 9

ARCHITECTURAL PLANNING

Module 9

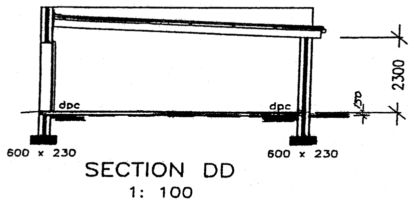
THE SKILL OF DRAWING ON SCALE

Activity 1:

To do an architectural drawing of the new classroom

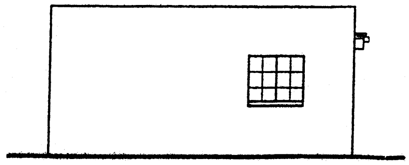
An architectural drawing is called a plan. The house you live in was first planned by an architect and the plans were given to the builder who built the house according to the plan. A plan is more complex than an orthographic drawing. It often includes the building materials, kitchen and bathroom layout, furniture, electrical points and water layout. All plans must comply with building regulations and must be approved by a local building department. Plans are used to determine the cost of a building. The building cost of a house these days varies from R2 000 to R5 000 per square meter (R2 000 - R5 000 / m2).

- The illustration below is a simple plan of a garage and store, which a person built next to his house.

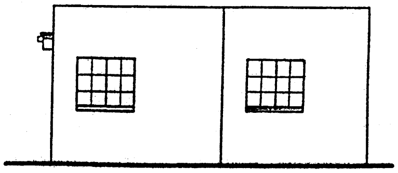


SECTION DD

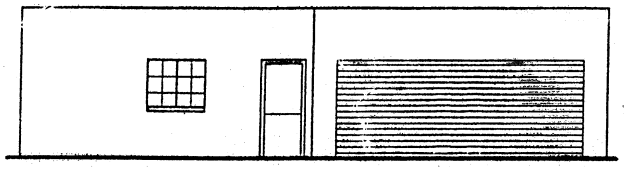
1:100



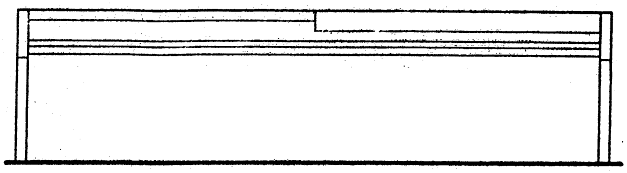
WEST ELEVATION: 1: 100



east elevation: 1:100



NORTH ELEVATION: 1: 100

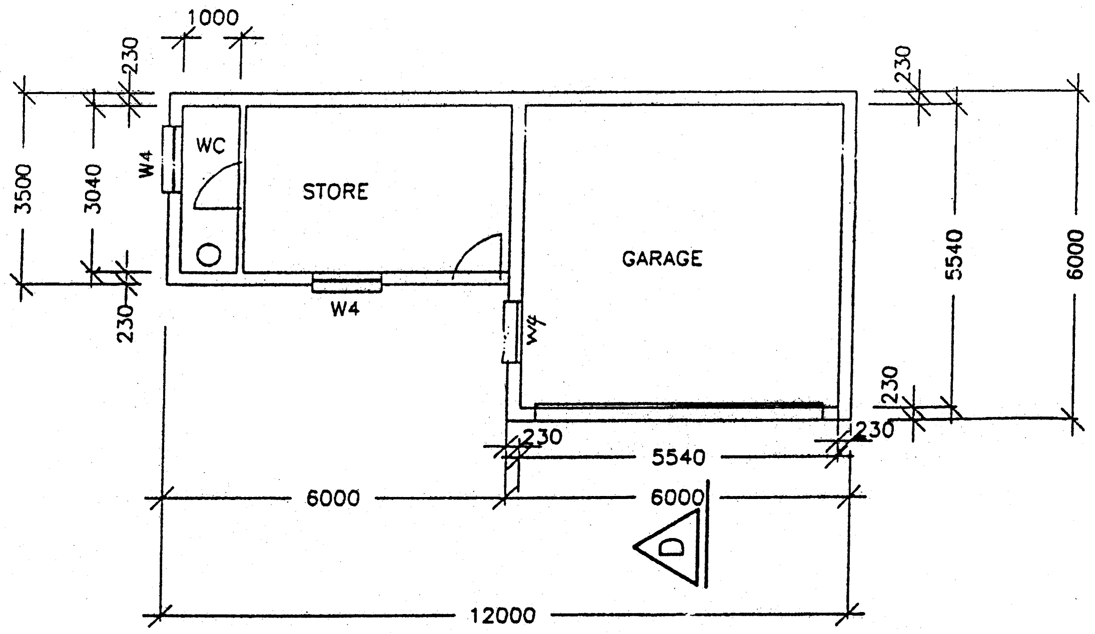


SOUTH ELEVATION: 1: 100

Focus task a

Use grid paper and produce a location drawing (plan view) of your classroom. You must indicate where the doors and windows are to be placed. Also add dimensions to your drawing. The grid will help you with the scale. Use one block for 1 meter. Calculate what the cost of the classroom will be if the building cost is R3 000 per square meter (R3 000 / m^2).

The following is an example of a plan view of a building.



FLOOR PLAN—GARAGE
1: 100

	LO 1.9			

Activity 2:

To develop a scale model of the new classroom

Most architects produce scale models to show their clients what the final product will look like. Materials such as paper, cardboard or styrofoam can be used to convert all the 2-D drawings into a 3-D model. Cardboard can easily be cut and then glued on to grid paper to establish the right scale. Add some colour and you have developed a demonstration model.

Focus task b

1. Produce a scale model of your classroom. You might leave one section of the roof off to show the layout on the inside.

	LO 1.10			

2. Formulate at least five criteria for the evaluation of your plan (refer to the design brief), and evaluate the model. Write down the outcome.

	LO 1.13			

3. Present your idea to the rest of the class.

	LO 1.15			

Assessment

Learning outcomes(LOs)
LO 1
TECHNOLOGICAL PROCESSES AND SKILLS The learner will be able to apply technological processes and skills ethically and responsibly using appropriate information and communication technology.
Assessment standards(ASs)
We know this when the learner:
investigates:1.1 identifies and explains a problem, need or opportunity from a real-life context, and investigates the context, the nature of the need, the environmental situation, and the people concerned;
1.4 uses a variety of available technologies and methods to: • locate (e.g. use library referencing system, database searches, indexes); • collect (questionnaires, data collection forms, requests for information, information searches, literature surveys);

- compare;
- sort;
- verify;
- evaluate;
- store information;

designs:1.5 writes or communicates a short and clear statement or a design brief for the development of a product or system related to a context, problem, need or opportunity that has been identified by self;

1.6 lists product specifications and design specifications and constraints for a solution to an identified problem, need or opportunity based on all of the design key words listed below:

- people, age, target market, human rights, access;
- purpose, function, what the product will do;
- appearance and aesthetics: form, colour, shape, feel;
- environment: where product will be used or made, impact on the environment in the long and short term;
- safety: for users and manufacturers;
- cost, cost of materials, wastage, cost of manufacture, maximum selling price;
- ergonomics;
- quality;
- production;

1.7 generates a range of possible solutions that are significantly different from each other, and that show clear links to the design brief and specifications and constraints;

makes:1.9 develops plans for making that include all of the following:

- resource lists (e.g. materials lists, tools, people, cost);
- formal drawings showing dimensions or quantities (e.g. orthographic, oblique or isometric views, sequence drawings, exploded views);

- manufacturing sequence;

1.10 chooses and uses appropriate tools and materials to make designed products with precision and control by measuring, marking, cutting or separating, shaping or forming, joining or combining, and finishing a range of materials accurately and efficiently;

evaluates:1.13 evaluates the product or system based on self-generated objective criteria linked directly to the design brief, specifications and constraints using self-designed procedures (e.g. surveys, questionnaires, testing procedures) for self-testing, and suggests sensible improvements or modifications that would clearly result in a more effective or higher-quality end product;

communicates:1.15 presents ideas (in a project portfolio) using formal techniques, in two-dimensional or three-dimensional sketches, circuit diagrams or systems diagrams that include all of the following features:

- use of SA conventional drawing standards (e.g. scale, outlines, dimension lines, first and first angle projection;
- notes that clarify design reasoning and key choices;
- impressive enhancements of significant sketches (e.g. colour, texture, shade, thick and thin lines, shadow).

How hydraulic systems work

TECHNOLOGY

Grade 9

HYDRAULIC AND PNEUMATIC SYSTEMS

Module 10

HOW HYDRAULIC SYSTEMS WORK

ACTIVITY 1:

To be able to describe how a hydraulic system works

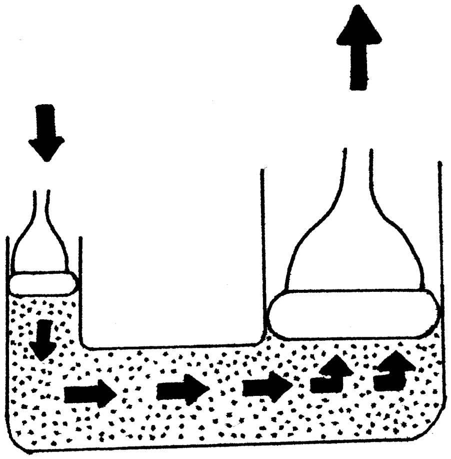
[LO 1.3, 2.3]

Pneumatic and hydraulic systems are systems that exert control so that the input-output relationship changes in such a way that tasks can be done faster with less force.

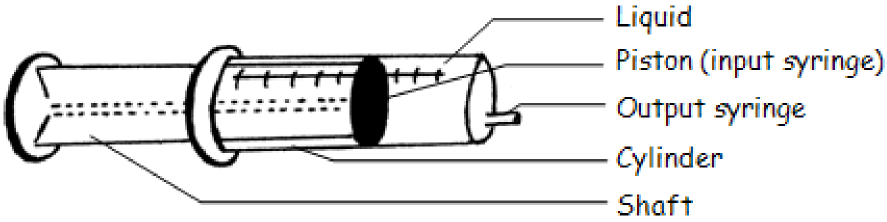
There are two kinds of hydraulic systems:

An open hydraulic system contains a liquid that is placed under pressure, for example water and a garden hose with a pressure nozzle.The system can also contain water that flows in a pipe when there is a difference in pressure, between the two ends of the pipe. Just think of the great advantage this device offers to farmers.

A closed hydraulic system: This consists of a sealed unit containing two pistons that are connected to each other by means of a pipe or reservoir. An input force on the smaller piston is transmitted in all directions by the liquid and imparts an output force on the larger piston. Because the pressure is transmitted in all directions in the liquid, the larger piston can have a greater output because of its larger area. All hydraulic systems work according to this principle.



A syringe can also be used to illustrate the way in which a hydraulic system works.



The piston on which the pressure is exerted, is called the master, or input, piston and the syringe that experiences the effect, is called the server, or output, piston.

In your own words, describe how a hydraulic system works. Also give two examples of hydraulic systems that are commonly used.

ACTIVITY 2:

To examine the transmission of pressure in a hydraulic system and to be able to describe it

[LO 1.3, 2.3]

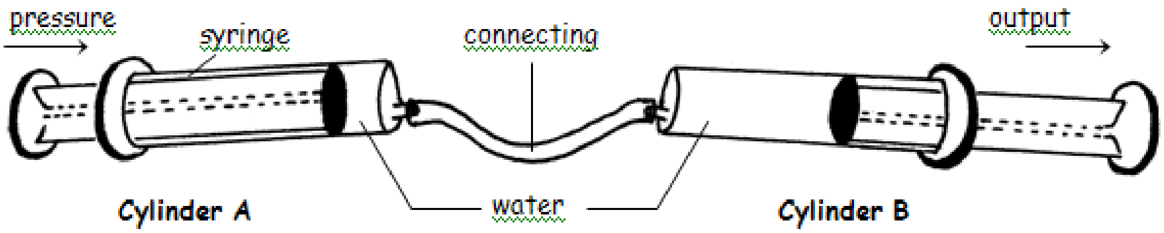
You need the following items for this research:

2 x 10 mℓ plastic syringes marked A and B

1 x plastic tube

Connect the cylinders as indicated in the figure and fill the system with water.

Wet both ends of the plastic tube and fix it to the syringes as indicated in the drawing.



1. Push the plunger of cylinder I in to a level of 2 cm deep. Make a note of your observation of the distance output in cylinder B.

2. Push the plunger of cylinder B in to a level of 2 cm deep. Make a note of the distance output in syringe A.

3. Has any mechanical advantage been observed?

4. Summary: The transmission of pressure in a hydraulic system.

ACTIVITY 3:

To examine the functioning of a pneumatic system and to compare it with that of a hydraulic system

[LO 1.3, 2.3]

Dry plastic syringes A and B and repeat the investigation done in Activity 2. This time draw up air into the cylinders instead of water.

1. What similarities exist between hydraulic and pneumatic systems?

2. What difference is there between the systems with regard to the effective transmission of the pressure?

ACTIVITY 4:

To examine the influence of the diameter of the piston disc on distance and power output and to be able to discuss it

[LO 1.3, 2.3]

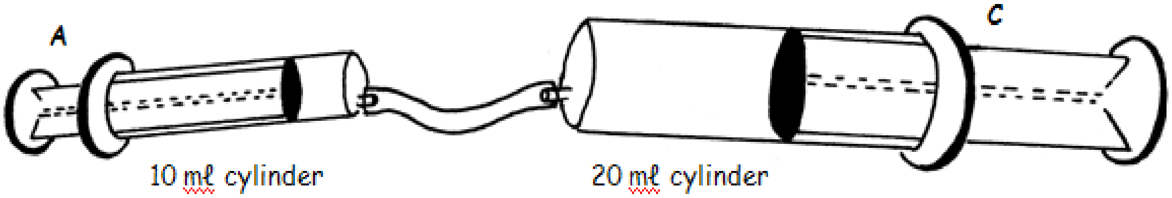
You will need the following items for this investigation:

1 x 10 mℓ cylinder marked A

1 x 20 mℓ cylinder marked C

a tube

Connect the cylinders as indicated in the figure and fill the system with water.



1. Push the plunger of cylinder A in so that it goes in 2 cm. Make a note of your observation of the distance output in cylinder C.

2. Push the plunger of cylinder C in so that it goes in 2 cm. Make a note of your observation of the distance output in syringe A.

3. What do you think will happen if the hydraulic system is replaced by a pneumatic system?

4. Replace the water with cooking oil and make a note of the difference / similarity in the functioning of the system.

5. Explain the advantages of using oil rather than water.

6. Summary of the results observed.

ACTIVITY 5:

To examine the connection between output distance, output force and diameter of the cylinder of hydraulic and pneumatic systems consisting of three cylinders

[LO 1.3, 2.3]

You need the following items to conduct this experiment:

1 x 20 mℓ syringe marked C

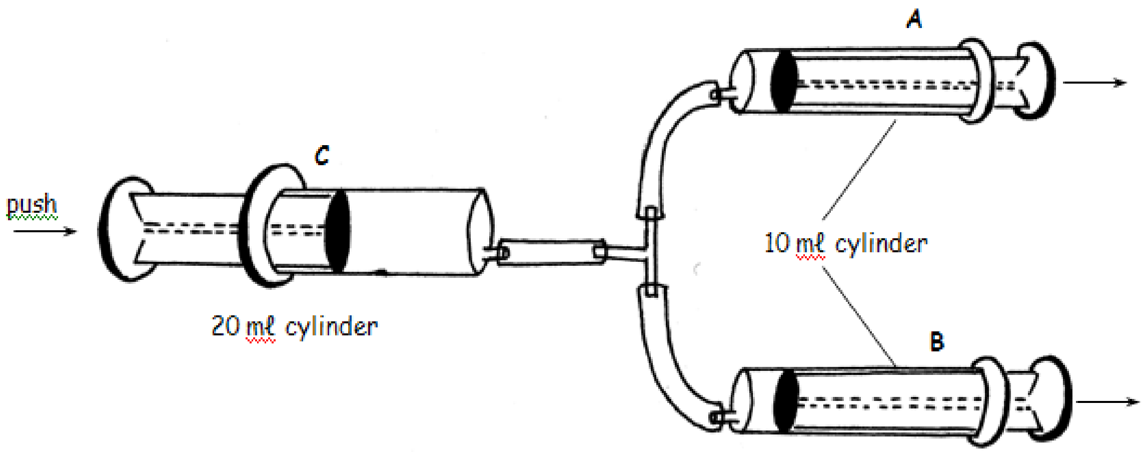
2 x 10 mℓ syringes marked A and B

3 x connecting tubes of the same size

1 x T connection

Fill syringe C with 10 mℓ water and fill both syringes A and B with 5 mℓ water.

Connect the syringes as indicated in the sketch.



1. Press the plunger of syringe C in 2 cm and indicate the distance output of syringes A and B.

2. Write down your observation.

Summary of the findings of Activities 1 to 5

Assessment

Learning outcomes(LOs)
LO 1
TECHNOLOGICAL PROCESSES AND SKILLSThe learner will be able to apply technological processes and skills ethically and responsibly using appropriate information and communication technology.
Assessment standards(ASs)

We know this when the learner:
investigates:1.1 identifies and explains a problem, need or opportunity from a real-life context, and investigates the context, the nature of the need, the environmental situation, and the people concerned;
1.2 analyses existing products relevant to an identified problem, need or opportunity based on:safety;fitness for purpose;cost;manufacturing method;
1.3 develops and performs practical testing procedures to determine or compare the suitability or fitness for purpose of relevant properties of materials, electrical or mechanical systems, structures, processes or finished products;
1.4 uses a variety of available technologies and methods to:locate (e.g. use library referencing system, database searches, indexes);collect (e.g. questionnaires, data collection forms, requests for information, information, searches, literature surveys);compare;sort;verify;evaluate (e.g. cross-checking different sources or resources);store information (e.g. filing systems, indexes);
designs:1.5 writes or communicates a short and clear statement or a design brief for the development of a product or system related to a context, problem, need or opportunity that has been identified by self;
1.6 lists product and design specifications and constraints for a solution based on all of the design key words listed below:purpose: function, what product will do;appearance and aesthetics: form, colour, shape, feel;
1.7 generates a range of possible solutions that are significantly different from each other, and that show clear links to the design brief and the specifications and constraints;

1.8 chooses possible solutions based on well-reasoned argument related to the specifications and personal options, develops a chosen idea using graphics;
makes:1.9 develops plans for making that include all of the following:resource lists;formal drawings showing dimensions or quantities;manufacturing sequence;
1.10 chooses and uses appropriate tools and materials to make designed products with precision and control by measuring, marking, cutting or separating, shaping or forming, joining or combining, and finishing a range of materials accurately and efficiently;
1.11 uses measuring and checking procedures while making to monitor quality and changes, and adapts designs in response to practical difficulties encountered when making products;
1.12 demonstrates knowledge and understanding of safe working practices and efficient use of safe working practices and efficient use of materials and tools.
LO 2
TECHNOLOGICAL KNOWLEDGE AND UNDERSTANDINGThe learner will be able to understand and apply relevant technological knowledge ethically and responsibly.
We know this when the learner:
systems and control:2.3 demonstrates knowledge and understanding of interacting mechanical systems and sub-systems by practical analysis and represents them using systems diagrams:gear systemsbelt drive or pulley systems with more than one stage;mechanical control mechanisms (e.g. ratchet and pawl, cleats);pneumatic or hydraulic systems that use restrictorsone-way valves;systems where mechanical, electrical, or pneumatic or hydraulic systems are combined.

Memorandum

ACTIVITY 1

A hydraulic system consists of two cylinders that are connected. Each cylinder contains a piston/plunger with a specific diameter and amount of liquid.

When the plunger is pushed in or drawn out, it causes a change in pressure that is propagated through the liquid. This pressure creates the mechanical force or kinetic advantage.

ACTIVTY 2

1. distance of delivery of piston B is 2 cm

2. the same/similar

3. no, the force/power is transferred with equal advantage (advantage =1)

4. The pressure in cylinder A is transferred to cylinder B.

ACTIVITY 3

1. The pressure is propagated from cylinder A to cylinder B.

2. The liquid/fluid propagates the pressure better than the air and offers greater resistance.

ACTIVITY 4

1. 1 cm

2. 4 cm

3. k will propagate less easily and the distance of delivery will not be exactly 1 and 4 cm respectively because air is compressible.

4. & 5. See synopsis

6. SYNOPSIS

With a piston that has a small diameter, the distance of delivery is great.

With a piston that has a greater diameter, the distance of delivery is small.

There will be better propagation of the pressure in the cylinder.

The density is greater and the force/power will therefore be propagated better than in water.

ACTIVITY 5

1. 2 cm at A and B respectively

2. The output of two 10-ml syringes each filled with 5 ml of water will be the same as the output of one 20-ml syringe containing 10 ml of water. The larger 20-ml syringe can control two 10-ml syringes if it contains twice (2 x 10 ml) the amount of water.

SYNOPSIS: ACTIVITY 1 – 5

A small force on a small piston/plunger produces a great force on a large piston/plunger.

A small piston/plunger will move over a large distance and a large piston/plunger over a small distance.

The larger piston/plunger is able to control a number of smaller pistons/plungers if its volume is equal to the sum of the volumes of the smaller pistons/plungers and the amount of water in the larger piston/plunger is equal to the combined volumes of the water in the smaller pistons/plungers.

Calculating the mechanical advantage of a hydraulic system

TECHNOLOGY

Grade 9

HYDRAULIC AND PNEUMATIC SYSTEMS

Module 11

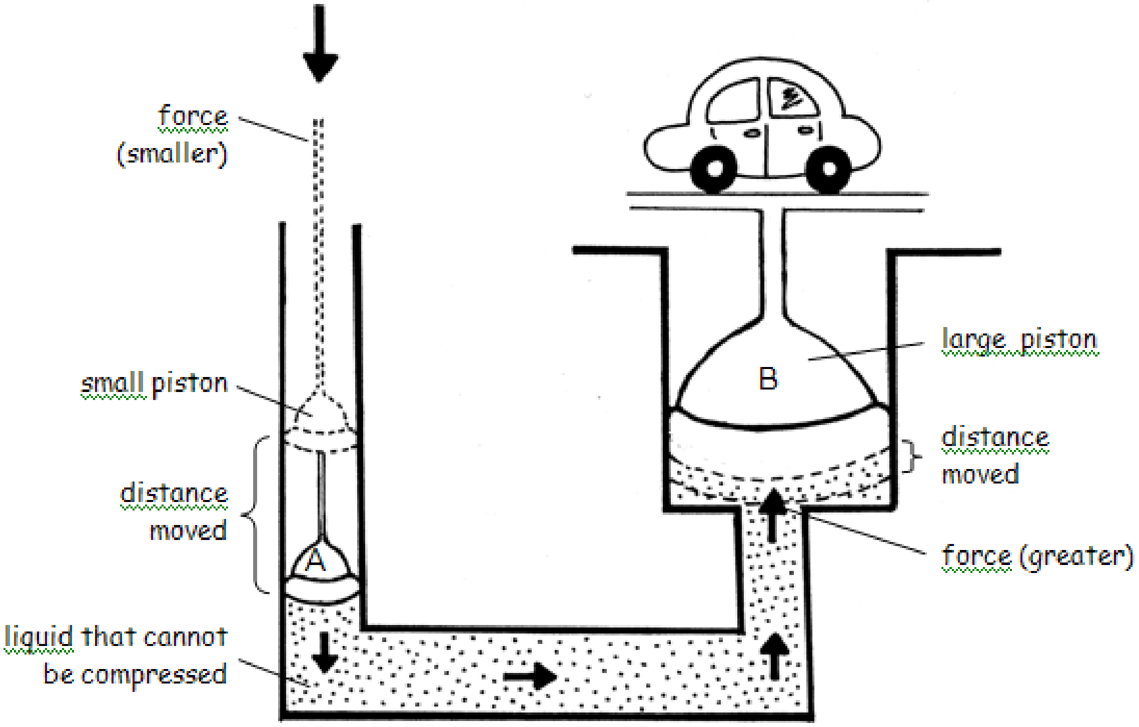
CALCULATE THE MECHANICAL ADVANTAGE OF A HYDRAULIC SYSTEM

ACTIVITY 1:

To calculate the mechanical advantage of a hydraulic system

[LO 2.3]

An example of a simple hydraulic system is a hydraulic lift which is used to lift motor-cars. The system has a mechanical advantage of both power input and distance output.



The system consists of two pistons of different sizes, connected by a reservoir that is filled with a hydraulic liquid such as oil or water.

Mechanical advantage – force multiplication:

A smaller input force on the small piston results in a greater output force on the large piston so that there is a mechanical advantage.

The input force is called the effort and the output force is called the load.

The advantage is made possible by two characteristics of liquids, namely that they cannot be compressed and that they distribute pressure equally.

This principle is called Pascal’s principle.

The pressure at piston A is equal to the pressure at piston B.

Pressure is calculated as force per area.
Equation:

$$\text{Pressure cylinder}A = \text{Pressure cylinder}B$$

$$\frac{F\text{orce}A}{\text{Area}A} = \frac{\text{Force}B}{\text{Area}B}$$

The following formula can be used to calculate the mechanical advantage:
Equation:

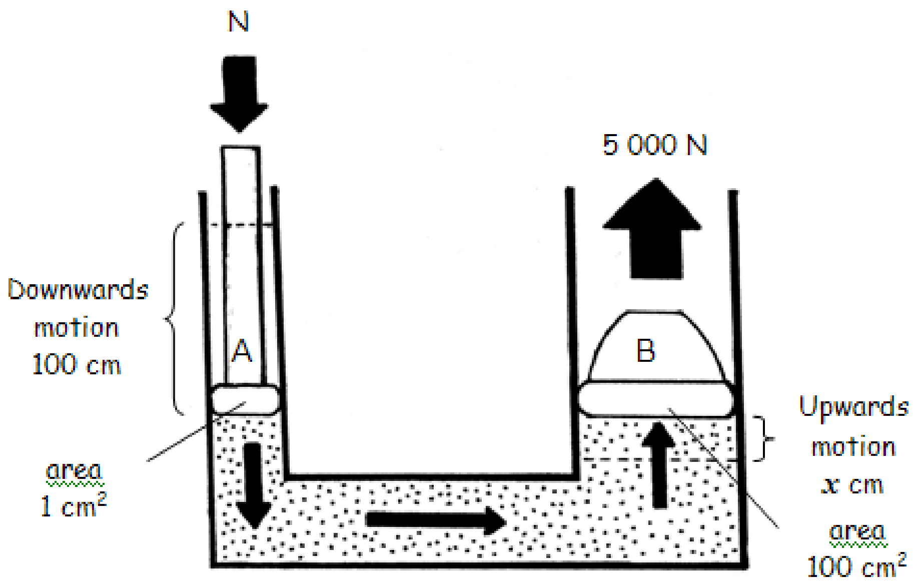
$$\text{Mechanical force advantage} = \frac{\text{load(output force)}}{\text{effort(input force)}}$$

Mechanical advantage – distance output:

In the syringes the piston with the large diameter will have a smaller distance output, and the piston with the small diameter will have a larger distance output. The relationship of distance output is determined by the mechanical force advantage.

Example:

The motor-car in the above example weighs 5 000 N. The small piston, A, has an area of 1cm². The small piston moves across a distance of 100 cm.



(a) Determine the input force. According to Pascal's principle:
Equation:

$$\text{Pressure cylinder} \text{A} = \text{Pressure cylinder} B$$

$$\frac{\text{Force A}}{\text{Area A}} = \frac{\text{Force B}}{\text{Area B}}$$

$$\frac{\text{Force A}}{1} = \frac{5\ 000\ \text{N}}{100}$$

$$\text{Force A} = 50\ \text{N}$$

The area at cylinder B is 100 times bigger. Therefore the power at cylinder A is 100 times smaller.

(b) Determine the mechanical force advantage.
Equation:

$$\text{MA} = \frac{\text{load}}{\text{effort}}$$

$$= \frac{5\ 000}{50}$$

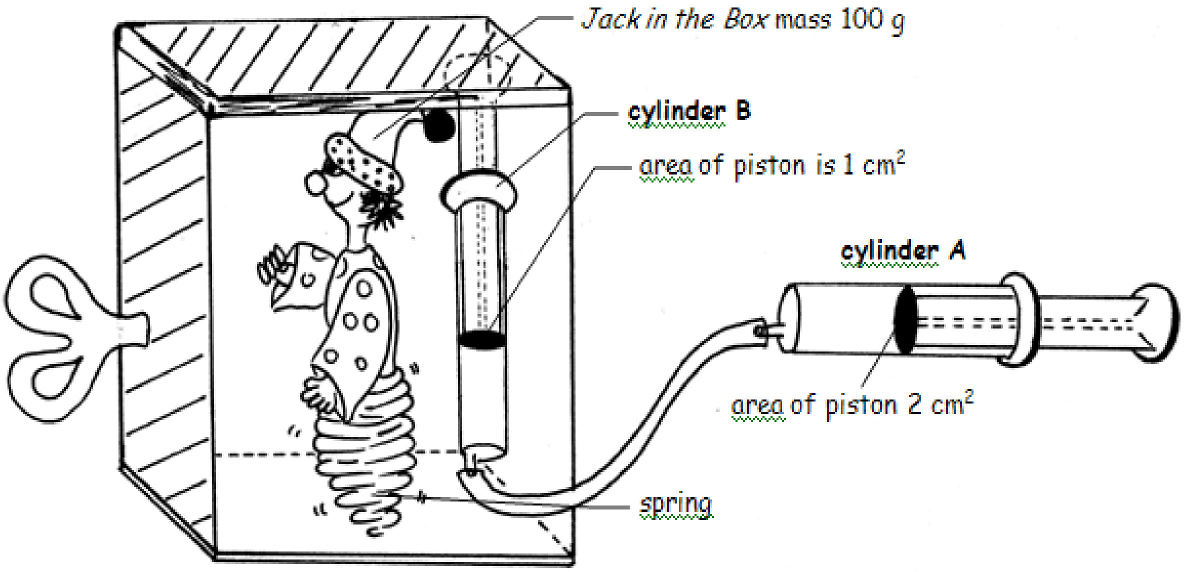
$$= 100$$

(c) Determine the distance that the large piston will move.

MA = 100. Therefore if the small piston moves 100 cm, the large piston will move 1 cm.

Test Your Knowledge

1. A little boy receives a Jack-in-the-Box toy from his grandmother (see illustration).



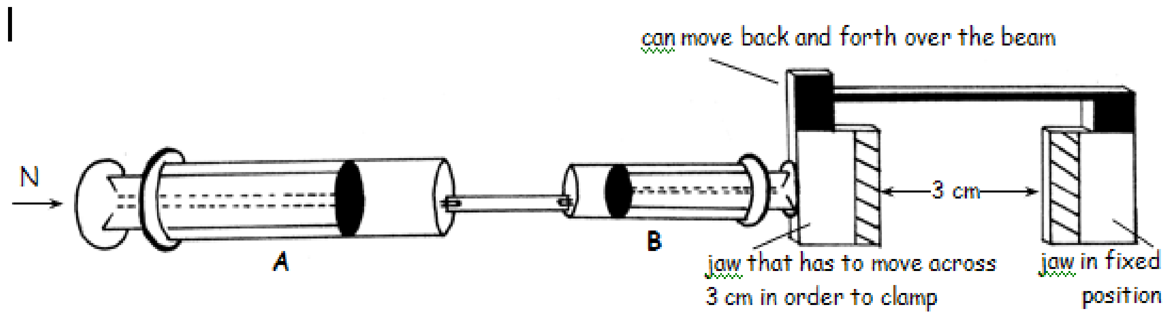
1.1 Calculate the amount of force, in Newton, that the little boy needs to make the Jack-in-the-Box weighing 100 g shoot out, when the area at cylinder A is 2cm² and the area at cylinder B is 1cm².

1.2 Calculate the mechanical advantage in question 1.1

1.3 Calculate the distance that piston A must move to make the Jack-in-the-Box shoot out 3 cm.

1.4 Would it be more advantageous to change around the two pistons, A and B?

2. You have to make a pair of hydraulic pliers, as indicated in the sketch. To enable you to do this, you are given two cylinders with pistons of 2 cm and 1 cm respectively. The maximum distance that the larger piston can move in the cylinder is 3 cm. A force of 1N is applied to move the moving jaws of the pliers over a distance of 3 cm and to clamp the jaws of the pliers.


can move back and forth over the beam
N
A
B
3 cm
jaw that has to move across 3 cm in order to clamp
jaw in fixed position

2.1 Which of the two pistons are you going to place in position A for a minimum force input? Explain your answer.

2.2 How far will the piston at cylinder A move to clamp the jaws?

Assessment

LO 2

TECHNOLOGICAL KNOWLEDGE AND UNDERSTANDINGThe learner will be able to understand and apply relevant technological knowledge ethically and responsibly.
We know this when the learner:
systems and control:2.3 demonstrates knowledge and understanding of interacting mechanical systems and sub-systems by practical analysis and represents them using systems diagrams:gear systemsbelt drive or pulley systems with more than one stage;mechanical control mechanisms (e.g. ratchet and pawl, cleats);pneumatic or hydraulic systems that use restrictorsone-way valves;systems where mechanical, electrical, or pneumatic or hydraulic systems are combined.

Memorandum

ACTIVITY 1

1.1 FORCE = 2 N

1.2 MA=1/2

1.3 1,5 cm

1.4 No, the small piston/plunger will move the furthest and enable Jack to make the highest jump

2.1 The piston/plunger with a diameter of 1 cm

2.2 1,5 cm

How valves function in hydraulic systems

TECHNOLOGY

Grade 9

HYDRAULIC AND PNEUMATIC SYSTEMS

Module 12

How valves function in hydraulic systems

ACTIVITY 1:

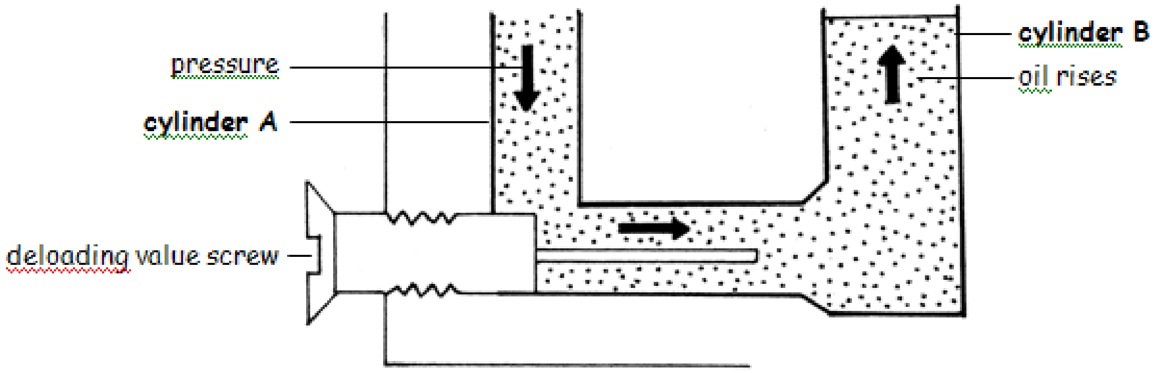
To be able to describe the functioning of valves in hydraulic systems

[LO 2.3]

The simplest valve is the one-way valve. It is used to keep the piston that moved up as a result of pressure on the hydraulic liquid, in position.

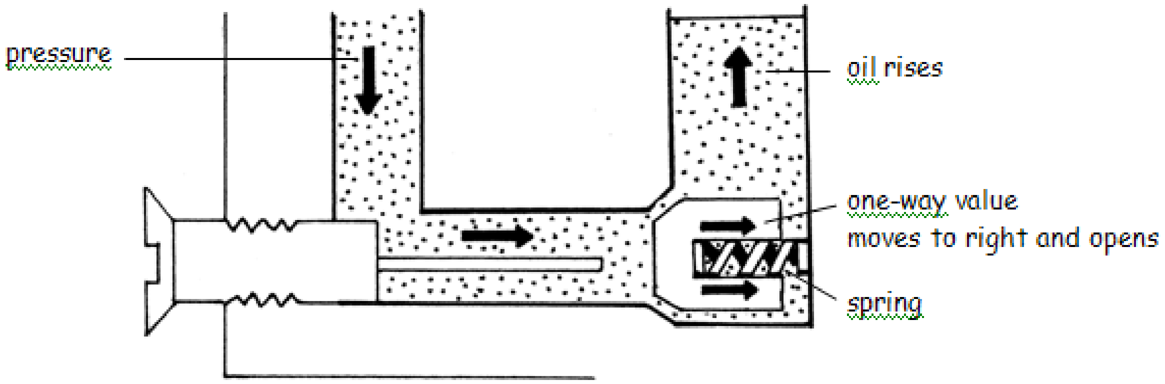
The valve is necessary because unlike gases, liquid cannot be compressed. The functioning of a valve can be explained as follows:

1. In the figure a force is exerted on the piston of cylinder A and is transmitted through the liquid as pressure. This causes cylinder B to rise and to experience a force.



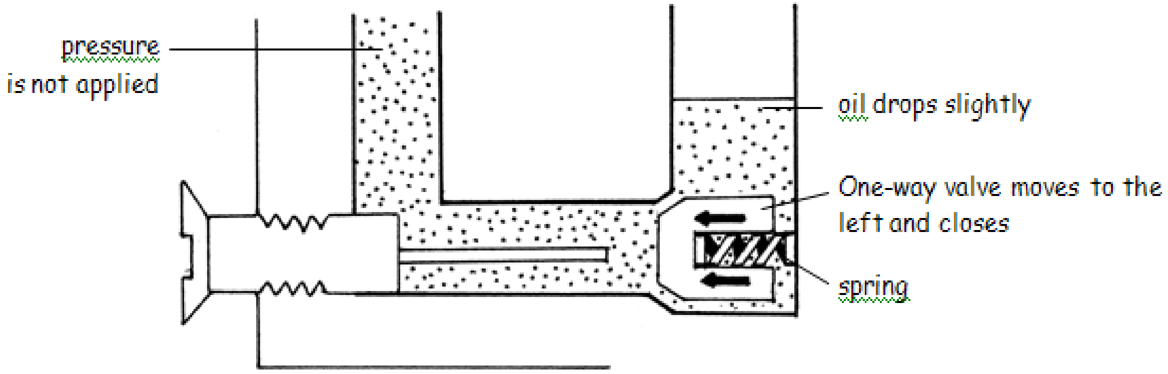
Should the force be removed, piston B will fall back again.

2. This can be prevented by using a valve that moves to the right when the force is exerted on piston A and moves to the left when the force is removed.



Pressure is distributed to the right through liquid and then the valve also moves to the right.

3. When pressure is no longer being exerted, the liquid recedes and the spring then forces the valve to move to the left.



The valve closes as a result of the liquid that recedes when the force is removed and this allows the spring to push the valve to the left.

Questions

Study figures 1 and 2 and answer the questions:

Figure 1: Here a hydraulic lift is used to lift the motor-car by moving the lever backwards and forwards.

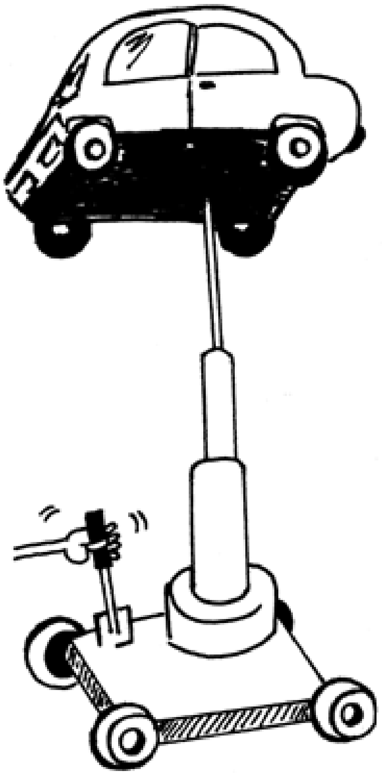
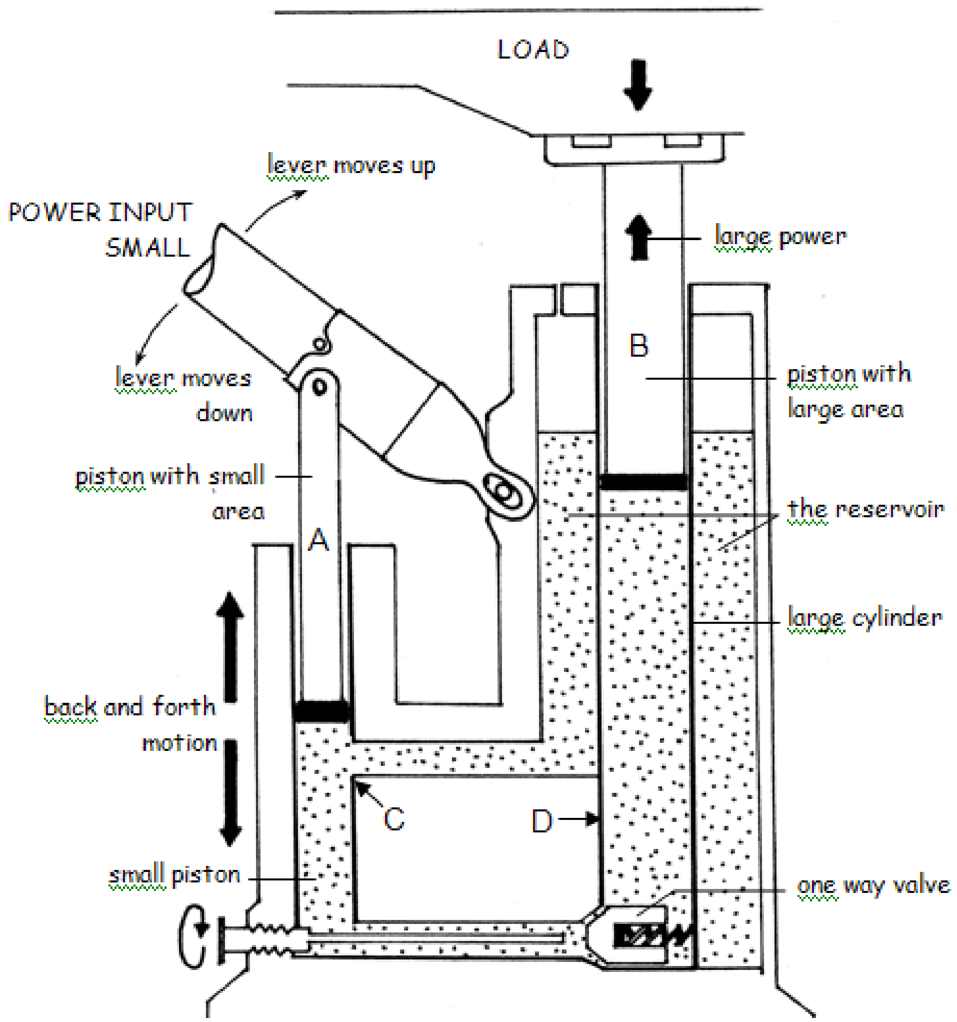


Figure 2: This is a cross-section of a simple hydraulic jack.



A single hydraulic jack consists of a small input piston, A, and a larger output piston, B. The oil is stored in the reservoir and is let into the system at point C.

A small force is exerted on the small area of the input piston, A, through the action of the lever. This causes a small amount of oil to move from the reservoir into the main cylinder, D. The one-way valve prevents the piston, B from moving back after the first pumping action, and in this way a great force is lifted little by little gradually lifting the car.

1. What is the function of the valves in both figure 1 and figure 2?

2. Why must the lever move back and forth in order to raise piston, B to the top?

3. Why is the diameter of the input cylinder smaller than that of the output cylinder?

Assessment

LO 2
TECHNOLOGICAL KNOWLEDGE AND UNDERSTANDINGThe learner will be able to understand and apply relevant technological knowledge ethically and responsibly.
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Memorandum

ACTIVITY 1

1. Prevents the reverse flow of the liquid/fluid so that the piston/plunger remains in position and the pressure is maintained.

2. When the lever moves upwards, a small amount of oil is released from the reservoir to the small cylinder.

When the lever moves downwards and input force is brought to bear on the small cylinder, the oil flows through the one-way valve to the large cylinder. The pressure is propagated through the liquid according to Pascal's principle and provides a great output force on the large cylinder.

When the lever is raised again, the one-way valve shuts and the oil is unable to flow back. This maintains the power advantage. The process is repeated from the beginning.

3. A small force on a small cylinder provides great force on a large cylinder.

Build a hydraulic system

TECHNOLOGY

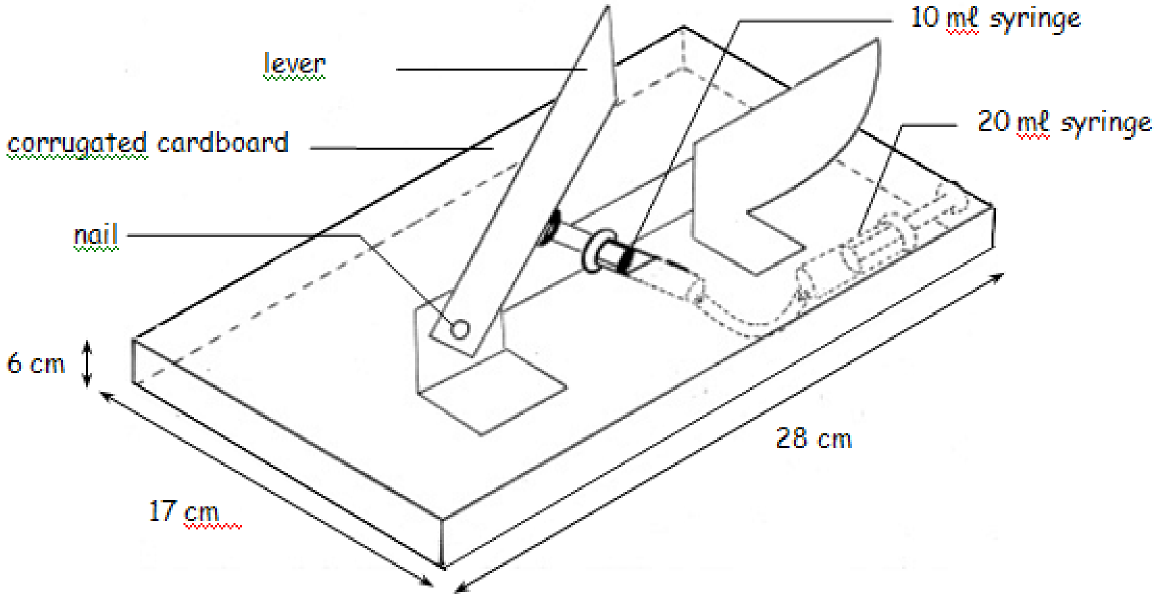
Grade 9

HYDRAULIC AND PNEUMATIC SYSTEMS

Module 13

TO BUILD A HYDRAULIC SYSTEM

Use the working drawing and build a model of a hydraulic system that is connected to a lever.



You need:

1 x 10 mℓ plastic syringe

1 x 20 mℓ plastic syringe

plastic tube (length as necessary)

a long nail

corrugated cardboard (Remember all the principles of reinforcing.)

a pair of scissors, glue, masking tape, adhesive tape

PROJECT:

THE TECHNOLOGICAL PROCESS

[LO 1.1, 3.2]

Use your knowledge of structures and / or electronics and / or mechanisms and integrate it with your knowledge and experience of hydraulic or pneumatic systems to solve ONE of the problems presented in the following situations. The problem must be solved in terms of a TECHNOLOGICAL PROCESS and be presented in a PORTFOLIO.

For the PRACTICAL WORK a prototype (as inexpensive as possible) must be built. This prototype must be able to function.

Use the assessment scales / matrixes to make sure that you comply with the requirements of the process.

Situation I

Your neighbourhood is plagued by blowflies. The residents of the neighbourhood have been asked in a number of newspaper reports to help combat the problem by keeping their dirt-bins tightly closed. However, it is not as easy as it seems. Stray cats that force their way into the bins and leave them open, are only part of the problem. The other great cause for concern is that germs are spread by these flies.

One of the residents came to the conclusion that he would have to design something that would make it possible for him to open the dirt-bin from a distance, and that would also warn him when the lid is open.

Situation II

Physically disadvantaged people often find it quite difficult to open the doors in cloakrooms that have been specially provided for their use.

Physically disadvantaged persons are usually only able to carry out a pushing motion using their hands, a walking-stick or the wheels of their wheel-chairs. This action must then enable them to open a door.

Situation III

Sticking stamps on an envelope can be very time-consuming and tiring when it is done on a large scale. A device that sticks the stamp and indicates that the task has been successfully completed, could solve the problem.

Steps of the Technological Problem that have to be followed:

1. SURVEY

1.1 ANALYSIS OF DESIGN PROPOSAL

Core of the problem

WHAT shall I do?

WHO will use it?

WHEN will it be used?

WHERE will it be used?

WHY will it be used?

[LO 1.1]

1.2 DESIGN PROPOSAL

Design and manufacture … what, for whom, where, why and when.

1.3 LIMITATIONS AND SPECIFICATIONS

Limitations: Requirements that limit the choice of solutions.

Specifications: Include limitations that are determined by the learner him- / herself. This is a list of factors that determine what the end product will look like and how it will function.

2. DEVELOPMENT OF IDEAS

2.1 RESEARCH

Research has to do with the skill of collecting data, noting it, analysing it and making decisions on the basis of the processed data.

Make a list of all the information that you need to develop your ideas.

Here are a few suggestions to help you:

STRUCTURES:

Materials that are available.

How can the materials be reinforced?

How are the different materials used?

ELECTRONICS

Which functions can be performed electronically?

Which electronic components are needed?

MECHANICAL SYSTEMS

Which mechanical advantage is required and how can you create it?

Surveys on the effect of different variables, e.g. gear ratios: conduct a study of gears of different sizes and determine the mechanical advantage.

PNEUMATIC AND HYDRAULIC SYSTEMS

What are the advantages and disadvantages of each system?

How easily can the system be combined with the structure or electronic system under consideration?

What function will the hydraulic or pneumatic system perform?

[LO 1.2, 1.3, 1.4]

2.2 DEVELOPING THREE IDEAS

Develop three ideas that could possibly offer solutions to the problem. The ideas must be creative and fall within the framework of the situation, limitations and specifications.

Present them graphically. All notes and captions must be supplied. A scale, 3-D sketches and shading are required.

[LO 1.5]

2.3 EVALUATING THE IDEAS

Evaluate the three above-mentioned ideas by referring to the situation, limitations and specifications.

Pay attention to the way in which the data are handled.

Present the data in the form of a table.

2.4 CHOICE AND MOTIVATION

Make an informed choice and give reasons for your choice.

Present the work in paragraphs.

[LO 1.6]

3. REALISATION

3.1 Draw a final design of the idea that has been selected.

3.2 Draw a flow diagram to indicate the order in which the final idea is to be constructed.

3.3 Provide a time schedule for the above-mentioned activities.

3.4 Make a list of the material and the tools that are needed.

3.5 Determine the cost by finding out how much material is required for the model, then find out the price of the material and submit a costing.

3.6 Draw very clear working drawings. All notes and captions must be supplied. 3-D sketches and shading are required.

3.7 Construct the prototype.

[LO 1.7, 1.8, 1.9, 1.10, 1.12]

4. EVALUATION:

4.1 Comment fully on the design achievements of the prototype.

4.2 Discuss the shortcomings of the prototype.

4.3 Make recommendations for the improvement of the prototype and design.

[LO 1.3]

5. VALUES AND ATTITUDES

5.1 Discuss the advantages that such a device could have for the community.

5.2 Discuss the disadvantages that such a device could have for the environment. (Consider issues such as pollution.)

{LO 3.2]

Assessment

Learning outcomes(LOs)
LO 1
TECHNOLOGICAL PROCESSES AND SKILLSThe learner will be able to apply technological processes and skills ethically and responsibly using appropriate information and communication technology.
Assessment standards(ASs)
We know this when the learner:
investigates:1.1 identifies and explains a problem, need or opportunity from a real-life context, and investigates the context, the nature of the need, the environmental situation, and the people concerned;
1.2 analyses existing products relevant to an identified problem, need or opportunity based on:safety;fitness for purpose;cost;manufacturing method;
1.3 develops and performs practical testing procedures to determine or compare the suitability or fitness for purpose of relevant properties of materials, electrical or mechanical systems, structures, processes or finished products;
1.4 uses a variety of available technologies and methods to:locate (e.g. use library referencing system, database searches, indexes);collect (e.g. questionnaires, data collection forms, requests for information, information, searches, literature surveys);compare;sort;verify;evaluate (e.g. cross-checking different sources or resources);store information (e.g. filing systems, indexes);
designs:1.5 writes or communicates a short and clear statement or a design brief for the development of a product or system related to a

context, problem, need or opportunity that has been identified by self;
1.6 lists product and design specifications and constraints for a solution based on all of the design key words listed below:purpose: function, what product will do;appearance and aesthetics: form, colour, shape, feel;
1.7 generates a range of possible solutions that are significantly different from each other, and that show clear links to the design brief and the specifications and constraints;
1.8 chooses possible solutions based on well-reasoned argument related to the specifications and personal options, develops a chosen idea using graphics;
makes:1.9 develops plans for making that include all of the following:resource lists;formal drawings showing dimensions or quantities;manufacturing sequence;
1.10 chooses and uses appropriate tools and materials to make designed products with precision and control by measuring, marking, cutting or separating, shaping or forming, joining or combining, and finishing a range of materials accurately and efficiently;
1.11 uses measuring and checking procedures while making to monitor quality and changes, and adapts designs in response to practical difficulties encountered when making products;
1.12 demonstrates knowledge and understanding of safe working practices and efficient use of safe working practices and efficient use of materials and tools.
LO 2
TECHNOLOGICAL KNOWLEDGE AND UNDERSTANDINGThe learner will be able to understand and apply relevant technological knowledge ethically and responsibly.

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systems and control:2.3 demonstrates knowledge and understanding of interacting mechanical systems and sub-systems by practical analysis and represents them using systems diagrams:gear systemsbelt drive or pulley systems with more than one stage;mechanical control mechanisms (e.g. ratchet and pawl, cleats);pneumatic or hydraulic systems that use restrictorsone-way valves;systems where mechanical, electrical, or pneumatic or hydraulic systems are combined.
LO 3
TECHNOLOGY, SOCIETY AND THE ENVIRONMENT The learner will be able to demonstrate an understanding of the interrelationships between science, technology and the environment.
We know this when the learner:
impact of Technology:3.2 recognises and identifies the impact of technological developments on the quality of people’s lives and on the environment in which they live, and suggests strategies for reducing and undesirable effects.